COMMITTEE ON LEAD, Etc., IN POTTERIES.

REPORT

OF THE

DEPARTMENTAL COMMITTEE

APPOINTED TO INQUIRE INTO

THE DANGERS ATTENDANT ON THE USE OF

LEAD

AND

THE DANGER OR INJURY TO HEALTH ARISING FROM

DUST AND OTHER CAUSES

IN THE MANUFACTURE OF

EARTHENWARE AND CHINA

And in the Processes incidental thereto,

INCLUDING THE MAKING OF LITHOGRAPHIC TRANSFERS.

VOL. I.—REPORT.

Presented to both Houses of Parliament by Command of His Majesty.

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WARRANTS OF APPOINTMENT.

I HEREBY APPOINT

Ernest F. G. Hatch, Esq.;*

William Burton, Esq., M.A., F.C.S., Clifton Junction, near Manchester;

Noel Buxton, Esq.;†

Bernard Moore, Esq., The Grange, Drayton-on-the-Moors, Stoke-on-Trent;

Noah Parkes, Esq., Secretary, North Staffordshire Trades and Labour Council;

George Reid, Esq., M.D., etc., Medical Officer of Health for Staffordshire;

Miss Tuckwell;

A. Vernon Harcourt, Esq., F.R.S.; and

John Ward, Esq., M.P.;

to be a Committee

To consider the dangers attendant on the use of lead in the various branches of the manufacture of china and earthenware, and in the processes incidental thereto, including the making of transfers, and to report how far these can be obviated or lessened

By improved appliances and methods in the lead processes; or

By conducting any of those processes in separate rooms; or

By limitation of the use of lead; or

By substitution of harmless lead compounds for raw lead; or

By substitution of other materials for lead; or

By controlling the employment of susceptible persons in lead processes; or

By precautions for detection of lead poisoning in the earlier stages,

or otherwise, and how far such precautionary measures are reasonably practicable generally and with regard to the several branches of the said manufacture.

To consider whether the danger or injury to health arising from dust or other causes in the said manufactures can be further obviated or lessened, and by what means, and how far such means are reasonably practicable generally and with regard to the several branches of the said manufacture.

To consider the existing Special Rules for the manufacture and decoration of earthenware and china, and the making of transfers, and to report what amendments, if any, are desirable for the better protection of the workers from lead poisoning and other diseases.

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* Now Sir Ernest F. G. Hatch, Bart.
† Now Member of Parliament.

And to consider and report what modifications, if any, are desirable in the application of the said Special Rules, so amended, to particular branches of the manufactures named above, in the form of Regulations under section 79 of the Factory and Workshop Act, 1901.

AND I FURTHER APPOINT

Ernest F. G. Hatch, Esq., to be Chairman, and

Edmund A. R. Werner, one of H.M. Inspectors of Factories,

to be Secretary of the said Committee.

(Signed) H. J. GLADSTONE.

Whitehall,
12th May, 1908.

I appoint Mr. Thomas Edwards, Secretary of the United Dippers, etc., Union, to be an additional member of the Departmental Committee on the dangers incidental to the use of lead, etc., in the manufacture of China and Earthenware.

(Signed) H. J. GLADSTONE.

2nd September, 1908.

DEPARTMENTAL COMMITTEE ON LEAD, ETC., IN POTTERIES.

REPORT.

TO THE RIGHT HONOURABLE WINSTON SPENCER CHURCHILL, M.P.,
His Majesty's Principal Secretary of State for the Home Department.

June, 1910.

Sir,

We have the honour to submit the following report dealing with the matters referred to us by His Majesty's Principal Secretary of State for the Home Department, in the warrant of appointment issued on the 12th May, 1908.

In so doing we have to point out that while the recommendations which we have made are very definite, they cannot in every instance be regarded as even expressing our final opinion; much will depend on the spirit in which, if adopted, they are carried out by employers and operatives, and in any case it is probable that from time to time questions will arise which could not be dealt with by a fresh Committee without a long period of preparation. If, at any stage in the steps which will be taken to establish a new code of regulations or even later, the Secretary of State should desire to call the Committee together again and consult it further, all the members would be ready to give him their assistance.

Potteries Visited.

The Committee as a whole visited 26 potteries which were carefully selected as being representative of the different branches of the trade.

Of these, 14 were situated in the North Staffordshire group of Pottery towns, 3 at Newcastle-on-Tyne, 8 in Glasgow and the neighbourhood, and 1 at Bristol.

In addition, the Chairman accompanied, as a rule, either by Mr. Vernon Harcourt or Mr. Burton, visited 36 other potteries, namely, 6 at Burslem, 4 at Fenton, 6 at Hanley, 9 at Longton, 2 at Stoke-on-Trent, 4 at Tunstall, 2 at Worcester, 2 at Lambeth, and 1 at Clifton Junction.

Lithographic Transfer Works Visited.

The whole Committee inspected a transfer-making establishment at Newcastle-on-Tyne; and visits by small sections of the Committee have been paid to similar works at Hanley and Longton.

Meetings of Committee.

Over and above the time spent in visiting works, the Committee have met on 92 days, on 25* of which evidence was taken, while the other 67 were occupied exclusively in deliberation. The Chairman of the Committee further attended at the Home Office for conferences on 114 days, besides devoting many hours to numerous informal discussions elsewhere.

The Chairman, accompanied in each case by at least one other member of the Committee, was also deputed to collect special information at four conferences, which were held as follows:—

(1) At Hanley on 17th August, 1908, when representative members of the National Amalgamated Society of Male and Female Pottery Workers laid before the Chairman and Mr. Noah Parkes a number of special points affecting pottery operatives.

(2) At Glasgow on the 23rd September, 1908, when a similar meeting of operatives was convened by the officers of the Glasgow branch of the National Amal-

* 22 days at the Home Office and 3 days at Stoke-on-Trent.

gamated Society of Male and Female Pottery Workers; on this occasion Mr. Noah Parkes was again present with the Chairman.

(3) At Stoke-on-Trent on 14th July, 1909, when representatives of the leading manufacturers of China Furniture and Electrical Fittings met to lay before the Chairman various considerations specially affecting their branch of the industry. At this conference the Chairman was accompanied by Mr. William Burton, M.A., F.C.S.

(4) At Stoke-on-Trent on 27th January, 1910, when about 70 leading representatives of every branch of the earthenware and china industry assembled to discuss with the Chairman the question of an Advisory Board;* at this meeting the Chairman was accompanied by Mr. William Burton and Mr. Bernard Moore.

Witnesses Examined.

In all, 71 witnesses have been examined, including medical men, practical chemists, operatives, representatives of Government departments, and manufacturers in addition to Mr. William Burton, Mr. Bernard Moore, and Dr. George Reid, members of the Committee.

The full list of witnesses, with references to their evidence, is as follows:—

Whitelegge, Benjamin Arthur, M.D., C.B., H.M. Chief Inspector of Factories	1–234
Legge, Thomas Morison, M.D., H.M. Medical Inspector of Factories	235–1162 and 15606–15664
Russell, John, M.D., of Burslem	1163–1394
Prendergast, W. D., M.D., of Hanley	1395–1678
Alcock, S. King, M.D., Certifying Surgeon, Burslem	1679–2212
Arlidge, John Frederick, L.R.C.P. & S., Certifying Surgeon, Stoke-on-Trent	2213–2542
Hill, Alfred Arthur, L.R.C.P. & S., Certifying Surgeon, Tunstall	2543–3124
Folker, Herbert H., M.R.C.S., L.R.C.P., Certifying Surgeon, Hanley	3125–3517
Vines, Miss Mabel Mary, H.M. Inspector of Factories	3518–4040
Partington, William, M.B., C.M., of Tunstall	4041–4251
Johnson, Gilbert Petgrave, M.D., D.P.H., M.O.H. for the Borough of Stoke-on-Trent	4252–4406
Dawes, Joseph William, M.B., C.M., M.O.H. for the Borough of Longton	4407–4606
Moody, Arthur Rowley, M.B., C.M., of Hanley	4607–4787
Faulds, Henry, L.F.P.S., L.M., of Hanley	4788–5049
Luson, Thomas, M.D., F.R.C.S., of Kingston	5050–5119
Shufflebotham, Frank, M.B., B.S., of Newcastle-under-Lyme	5120–5488
Lovatt, Joseph, General Secretary of the National Amalgamated Society of Male and Female Pottery Workers	5489–5934
Booth, Jabez, for the National Amalgamated Society of Male and Female Pottery Workers	5935–6033
Clowes, Samuel, for the National Amalgamated Society of Male and Female Pottery Workers	6034–6199
A., for the National Amalgamated Society of Male and Female Pottery Workers	6200–6277
B., for the National Amalgamated Society of Male and Female Pottery Workers	6278–6446
C., for the National Amalgamated Society of Male and Female Pottery Workers	6447–6712
D., Tile-maker, for the National Amalgamated Society of Male and Female Pottery Workers	6713–6732
E., for the Glasgow Branch, National Amalgamated Society of Male and Female Pottery Workers	6733–6916
Elkin, William, for the Dippers' and Ovenmen's Union	6917–7037
Bennett, Richard, for the Dippers' and Ovenmen's Union	7038–7203
Redgrave, Jasper Alexander, I.S.O., H.M. Superintending Inspector of Factories, Midland Division	7204–7742
Cunynghame, Sir Henry H. S., K.C.B., Legal Assistant Under Secretary of State for Home Department	7743–8046 and 8526–8530
Hillier, Joseph Hillier, Controller of Supplies, H.M. Office of Works	8047–8133
Hartnell, Henry, Staff Engineer, Chief Engineer's Department, Post Office	8134–8190
Walmsley, James Henry, H.M. Inspector of Factories (now H.M. Superintending Inspector)	8191–8525
Shuter, Sidney, H.M. Inspector of Factories	8531–8788
Evans, E. P., Managing Director, Worcester Royal Porcelain Co., Ltd.	8789–9063
Carter, Owen, of Carter & Co., Tile Manufacturers, Poole	9064–9239
Heath, Frederick, of James Reeves & Co., Earthenware Manufacturers, Fenton	9240–9323

* See page 126.

JOHNSTON, T. B., Managing Director of Pountney & Co., Ltd., Earthenware Manufacturers, Bristol	9324–9505
MASSEY, ENOCH, of E. Hughes & Co., China Manufacturers, Fenton	9506–9649
THOMASON, W., F.I.C., Chemist to Doulton & Co., Ltd., Potters and Enamelled Metal Sanitary Ware Manufacturers, of Lambeth, &c.	9650–9881 and 15341–15605
MALING, CHRISTOPHER THOMPSON, of C. T. Maling & Sons, Earthenware Manufacturers, Newcastle-on-Tyne	9882–10126
PLANT, S. L., of R. H. & S. L. Plant, China Manufacturers, Longton; President, English China Manufacturers' Association	10127–10239
WOOLLEY, ARTHUR, of Blair & Co., China Manufacturers, Longton; for the English China Manufacturers' Association	10240–10291
HORN, JOSEPH S., of Horn Bros., Earthenware Manufacturers, Australian Pottery, Ferrybridge, Yorkshire	10292–10340
KEELING, JOSEPH, of Keeling & Co., Earthenware Manufacturers, Burslem	10341–10436
EVEREST, HORACE ARTHUR, Chief Clerk to the Receiver for the Metropolitan Police District	10437–10484
JULEFF, J., representing the Prison Commission	10485–10545
BLACK, F. W., C. B., Director of Contracts for the Navy	10546–10582
UNDERHILL, T. J., Inspector of Admiralty Victualling Stores	10583–10617
MOORE-LANE, Lieut.-Colonel, Chief Inspector of General Stores at Woolwich	10618–10689
ANDERSON, Miss A. M., H.M. Principal Lady Inspector of Factories	10690–10931
THORPE, THOMAS EDWARD, C.B., F.R.S. (now SIR EDWARD THORPE), Principal of the Government Laboratory	10932–11326
GOODE, MINTON, of Thomas Goode & Co., Earthenware and China Retailers, South Audley Street, W.	11327–11387
OLIVER, SIR THOMAS, M.D., F.R.C.P., &c., Physician to the Royal Infirmary, Newcastle-on-Tyne	11388–11616
F., Mrs., Operative, Saucer Maker	11617–11717
G., Miss, Operative, Ware Cleaner	11718–11754
H., Mrs., Operative, Majolica Paintress	11755–11834
I., Miss, Operative, Colour Blower	11835–11846
BAILEY, J. C., General Manager, Royal Doulton Potteries, Burslem; Chairman of the Staffordshire Potteries Manufacturers' Association	11847–12528
JACKSON, W., A.R.C.S., Chemist to Alfred Meakin, Ltd., Earthenware Manufacturers, Tunstall	12529–12676
BURTON, JOSEPH, A.R.C.S., A.I.C., Chemist and Works Manager of Pilkington's Tile & Pottery Co., Clifton Junction	12677–12939
JOHNSON, H. J., Director of Johnson Bros. (Hanley), Ltd., Earthenware Manufacturers, Hanley and Tunstall	12940–13454
MELLOR, J. W., D.Sc., Instructor in Pottery, County Technical School, Stoke-on-Trent	13455–13650
RIDGWAY, JOHN, of Ridgways, Earthenware Manufacturers, Shelton, Staffs.	13651–13795
WEDGWOOD, LAWRENCE, of Josiah Wedgwood & Sons, Ltd., Earthenware and China Manufacturers, Etruria, Staffs.	13796–14010
WATKIN, HENRY, of Macintyre & Co., Ltd., China Furniture and Electrical Fittings Manufacturers, Burslem	14011–14206
BISHOP, DUNBAR F. W., of Bishop & Stonier, Earthenware and China Manufacturers, Hanley	14207–14319
KENNEDY, JOSEPH, of H. Kennedy & Sons, Stoneware Potters, Barrowfield, Glasgow	14320–14504
SERVICE, EDWARD, of Caledonian Pottery Co., Ltd., Stoneware and Rockingham Manufacturers, Rutherglen, Glasgow	14505–14530
MOORE, BERNARD (a Member of the Committee)	14531–14717
GOADBY, K. W., M.R.C.S., D.P.H., of London	14718–14892
BURTON, WILLIAM, M.A., F.C.S. (a Member of the Committee)	14893–15340
REID, GEORGE, M.D., D.P.H. (a Member of the Committee)	15665–15904

CLASSIFICATION OF POTTERIES ACCORDING TO RULES IN FORCE.

SPECIAL RULES.

In addition to the general provisions applicable to all factories under the Factory Act, 1901, the Home Office have on four separate occasions, viz., in 1894, 1898, 1901 and 1903, issued Special Rules, under the Factory Act of 1891, for the regulation of those potteries in which the operations are of a dangerous nature.

According to the latest Home Office returns (Jan. 1st, 1908), the numbers of potteries, respectively subject to these several codes, are:—

Under Special Rules issued	1894	43	potteries
,, ,,	1898	23	,,
,, ,,	1901	3	,,
,, ,,	1903	481	,,
Total subject to Special Rules of one class or another		550	,,

Reasons for Existence of Different Codes.

The difference in the treatment of these potteries is the direct result of the formalities required by the Factory Act of 1891. Under normal circumstances it might have been expected that they would all have been placed under the latest code of Special Rules issued in 1903, but by this Act it was provided that, in the establishment of any Special Rules, the occupiers of factories should receive formal service of a copy of them, and an opportunity of objecting to them. Of this opportunity the 69 potteries at present under the Special Rules of 1894, 1898, and 1901, availed themselves, and the Home Office did not consider that in their case the additional precautions, enforced by the newer codes, were absolutely essential. They were consequently permitted to remain under the special codes to which they were, in the first instance, respectively subjected.

The Committee do not think it desirable to perpetuate such a form of special treatment, but recommend that every pottery, every mill where materials for use in earthenware and china works are ground and prepared, and all similar factories or workshops* should be controlled by such regulations as will secure a uniform standard of safety under all the varying conditions obtaining in the different branches of the industry. Presumably, however, certain modifications will, without involving risk of injury to workers, be capable of adoption for special classes of potteries, and such will be indicated in connection with the detailed recommendations of the Committee set forth later in this Report.

Lithographic Transfer Works.

Besides the potteries proper, there are seven works engaged in making lithographic transfers, that is to say, coloured designs which can be transferred to articles of pottery for the purpose of decoration. The processes of manufacture involved are classed as dangerous and are subject to the rules set forth in the code of 1899 (see Appendix I.).

Geographical Distribution of Potteries.

A large portion of the Pottery Industry is concentrated in the group of towns known as the North Staffordshire Potteries, viz., Burslem, Fenton, Hanley, Longton, Stoke-on-Trent, Tunstall.† Of the 550 potteries tabulated above, as many as 329 are situated in this district.

The remaining 221 works are scattered over the United Kingdom. The largest groups of these are as follows:—

Dorsetshire (Poole)	14
Shropshire (Coalport and district)	6
South Derbyshire (Swadlincote and district)	26
North Derbyshire (Chesterfield)	12
Yorkshire West Riding (Castleford and district)	6
Scotland East (Kirkcaldy and district)	7
Scotland West (Glasgow and district)	16
Devonshire	10

Isolated pottery manufactories of notable importance are also situated at:—

Newcastle-on-Tyne.
Derby.
Clifton Junction, near Manchester.
Worcester.
Bristol.
Belleek.

* See further on page 7. † Now constituting the County Borough of Stoke-on-Trent.

Number of Persons Employed in the Industry and the Proportion Engaged in Lead Processes.

According to the latest returns*, the above 550 factories provide employment for some 63,000 workers, of whom nearly 48,000 are employed in North Staffordshire, and the remaining 15,000 in other parts of the country. These 63,000 workers may be classified as follows:—

Workers in dangerous processes involving contact with lead - - - - - - - - - - -		6,865
Workers incurring danger from breathing dust other than that of lead - - - - -	about	23,000†
Workers not engaged in dangerous processes -	about	33,000
Total - - - - - -	about	63,000

Workers Employed in Unhealthy Processes.

Those therefore who are engaged in scheduled‡ processes in which the chief danger is lead poisoning amount only to about 11 per cent. of the total number employed in the industry, and the statistics collected by the Factory Department in pursuance of Section 130 of the Factory and Workshop Act, 1901, include full details of the number employed in each process involving contact with lead; but a much larger proportion, *i.e.*, about 36 per cent., are liable to inhale the dusts of clay, flint, or other materials used in the manufacture of the ware, and no attempt has hitherto been made to distinguish them by any system of classification from other non-lead workers. The Committee are of opinion, as will later be explained, that the illnesses resulting from such dusts and the conditions of work connected with them, are very serious and far more wide-spread than lead poisoning, and desire to point out that it is at least as important to collect statistics of the numbers liable to breathe silicious, clay or other dusts as of the lead workers of whom a careful tabulation has been made.

In default of accurate figures various estimates have been formed of the number of workers affected by this general dust, and the consensus of opinion is that it amounts to some 23,000. It thus appears, if the lead workers are added to these figures, that nearly one half of the operatives employed in the manufacture of earthenware and china are liable to inhale noxious dust of one kind or another. The other half are employed in subsidiary occupations such as printing and painting on pottery, warehouse work, sorting, wrapping, and packing; and though it is possible that a few of them, owing to their proximity to such dust, may come into contact with it, taken as a whole they must be regarded, so far as their actual occupation is concerned, as being engaged in work no more unhealthy than the average factory or workshop operative employed in an industry not scheduled as a dangerous trade.

Composition of Pottery Ware.

In the manufacture of a piece of pottery there are generally two component parts:—

(1) The substance known as "the body," which is porous in character and may be made either of simple native clay unmixed with other ingredients, or composed of several, such as Cornish stone, china clay, combined in the case of British china with calcined bone, or in that of earthenware with ball clay§ and calcined flint.

(2) The glaze, *i.e.*, a preparation of various silicates and silico-borates, to which is usually added a lead compound; this is applied at a later stage for the double purpose of rendering the porous body impervious, and of imparting to the surface a smooth glass-like finish.

Different Branches of the British Pottery Industry.

The manufactures in the production of which the Pottery Industry is mainly engaged may be enumerated as follows:—

(1) China.
(2) Earthenware.
(3) Tiles.
(4) Majolica.
(5) Jet and Rockingham.
(6) China Furniture and Electrical Fittings.
(7) Sanitary Ware.

* As made to the Chief Inspector of Factories early in 1908, for the year 1907.

† This is only an estimated figure, in absence of statistics: see explanation in next paragraph.

‡ In 1901 a Schedule of dangerous processes was appended to the code of Special Rules issued by the Home Office, and such are commonly referred to as "Scheduled Processes" (*see* page 97).

§ A clay found in Devon and Dorset, more plastic than china clay, but not so white.

China.

All translucent ware, generally speaking, is embraced in the term "china," but the great bulk of that made in this country contains a large percentage of calcined bone, and in practice only those potteries have been treated by the Home Office as "china" factories in which this bone china is made. In a few potteries a translucent effect is obtained by means of felspar, but of these, although in the true sense "china" factories, many have hitherto been classified as making earthenware.

Earthenware.

This category includes the great bulk of opaque ware, plain and decorated, made principally for domestic and general use; the body is usually made up of ball clay, china clay, flint and stone.

Tiles.

In the manufacture of tiles the material used is similar to that from which earthenware is made, but instead of being worked in a plastic state it is reduced to dust and moulded under pressure.

This class of pottery only embraces ornamental tiles, white and coloured, plain or decorated, and all tiles "other than ornamental" are expressly excluded by the Factory Act, 1901. The purpose of the Act was to make an exception of "coarse ware" tiles such as are used for roofs, but the Committee do not consider that the definition is a satisfactory one. Several varieties which might certainly be regarded as not being ornamental, are made from powdered clays by the dust-pressing process,* and, as the manufacture of these involves the same risk of dust inhalation as that of ornamental tiles, they should be subject to the same regulations.

The Committee therefore suggest that any future certificate of the Secretary of State relating to the manufacture of earthenware and china should specifically include all varieties of tiles which are made by the compression of powdered clays, unless it can be shown that the material is used with so much moisture as to prevent the formation of dust.

Majolica.

This name is used to denote decorative ware made of the same body as earthenware (or from red or yellow clays), but the glaze before application is mixed with colouring oxides or pigments.

Jet and Rockingham.

This class includes all articles made from simple brown clays unmixed with other ingredients, and the glaze used contains either cobalt or manganese. In the former case the ware becomes black and is known as Jet, in the latter it assumes a rich brown hue, frequently interspersed with deep plum-coloured shades, and is called Rockingham. Small quantities of the finer varieties of these articles are made with ordinary earthenware or special black bodies.

China Furniture and Electrical Fittings.

In this category are included the innumerable small bits of ware which do not as a rule appear by themselves in crockery shops, but are used in the construction of other articles or in conjunction with them. They are of infinite variety; heat insulators for teapot handles, eyelet rings for looms, door knobs and castor rollers may be cited as examples of them, as well as such products as finger plates, nest eggs, ink wells, and electrical fittings for purposes of insulation. Most of this ware is made with an earthenware body, but a proportion of many kinds, such as castor bowls and milliners' window fittings, are manufactured in the same way as Jet.

Sanitary Ware.

This branch includes the manufacture of baths, closets, urinals, operating tables, lavatory basins, etc.; some classes of sanitary ware are made with a fireclay body, others with a body similar to that of earthenware.

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* See page 55.

Distribution of Lead Workers in the various Branches of the Trade.

It has already been mentioned that there are 6,865 workers engaged in scheduled lead processes. They are distributed between the various branches of the trade as follows:—

Manufacture.	No. of Lead Workers employed (1907)
China - - - - - - - - -	927
Earthenware - - - - - - - -	3,946
Tiles - - - - - - - - -	961
Majolica - - - - - - - -	266
Jet and Rockingham - - - - - -	241
China Furniture and Electrical Fittings - - -	245
Sanitary Ware - - - - - - -	279
Total - - -	6,865

As previously stated, no detailed statistics are available of the number of workers exposed to the risk of inhaling dusts other than that of lead; they cannot therefore be classified under the separate branches of the trade.

Kindred Works Classified with Earthenware and China Factories, but not under Special Rules.

In addition to the 550 potteries above-mentioned, there are some 500 kindred factories employing about 11,000 workers, which the Home Office have not as yet brought under the Special Rules for the manufacture of earthenware and china. Some of these are pottery works where the output consists only of coarse ware, glazed or unglazed; of stone ware, such as ginger-beer bottles; or of such common pottery as can be made from a natural clay without admixture, and is generally coated with glazes free from lead. In others, again, no pottery is made, but the materials for its manufacture, such as flint, stone, bone and glaze, are ground and prepared for use. Hitherto, none of these factories have been considered as standing in need of urgent attention, and beyond the fact that 31 of them have been scheduled with a view to being placed under a modified code of rules, no steps have been taken to provide for their better regulation. The Committee are, however, strongly of opinion that, while due regard should be paid to the circumstances of each particular case, every factory in which pottery of any kind is made, or in which the materials for its manufacture are prepared, should, in respect of the danger due to lead, be made subject to the same regulations as those prescribed for similar processes in ordinary earthenware and china works. The Committee, moreover, have themselves noted instances of factories not under Special Rules in which the exposure to dust other than lead is considerable, and they feel that in the majority of the 500 factories in question, the latter risk is probably as rife as in many others in which Special Rules are enforced; they consider, therefore, that from this point of view also, these factories should be carefully classified and suitable regulations adopted for the protection of the workers.

USE OF LEAD.

Ordinary earthenware and china bodies, whether made of a simple local clay or of a more or less complex mixture of clay, stone, flint, bone, and other substances, are in themselves porous, and would be quite useless for holding liquids unless the body were coated with a layer of an impervious material.

Glaze.

This impervious layer, as already mentioned, is known as "glaze," and for centuries past compounds of lead have been widely used in its production. Evidence has been put forward that a very good glaze can be procured apart from lead, and that such "leadless" glazes are quite efficacious and suitable, though some of them are stated to render the finished article more costly to produce. On the other hand, it is affirmed that a lead glaze has distinct advantages; the covering which it gives, whether to earthenware or china "bodies" as made in this country, is said to be more perfect than any that can be obtained by other means, and in consequence the goods, in either case, are more marketable.

Different Lead Compounds used.

Glazes.—The particular compound most generally used in this country for ordinary lead glazes is the carbonate of lead known as white lead. For certain grades of pottery, glazes are used which have for their principal ingredient an oxide of lead, either red lead or litharge, or the native sulphide of lead known as galena.

Colours.—In addition to the lead compounds so widely used for making up glazes, certain compounds of lead are also used in some of the colours with which articles of pottery are decorated.

Lead Poisoning.

Unfortunately the use of these lead compounds is liable very seriously to affect the health of the workers, inasmuch as, when constantly handled and especially if inhaled as dust, they give rise to lead poisoning. Public attention has, in consequence, been widely aroused, and for many years past there has been a definite agitation against the unrestricted use of such lead compounds.

The records of lead poisoning cases occurring in pottery factories date from the year 1896, when the Act imposing on medical men and occupiers of factories the duty of reporting such cases, came into force. Both for that year and 1897 the figures are probably very incomplete; but taking them as they stand, the number of cases recorded from 1896 to 1900 is sufficiently great to warrant the assumption that lead poisoning was prevalent to a much larger extent in earlier times.

Table showing Lead Poisoning Cases in Potteries from 1896 *to* 1909.

Year.	Reported Cases in		
	North Staffs. District.	Rest of United Kingdom.	Whole of United Kingdom.
1896 - - - - - -	432		432
1897 - - - - - -	446		446
1898 - - - - - -	348	109	457
1899 - - - - - -	204	45	249
1900 - - - - - -	165	35	200
1901 - - - - - -	84	22	106
1902 - - - - - -	66	21	87
1903 - - - - - -	75	22	97
1904 - - - - - -	84	22	106
1905 - - - - - -	75	9	84
1906 - - - - - -	85	22	107
1907 - - - - - -	82	21	103
1908 - - - - - -	91	26	117
1909 - - - - -	49	9	58

As already stated, special efforts were made in 1894, 1898, 1901, and 1903 to formulate such rules as would put an end to lead poisoning throughout the industry, and in the course of the arbitration proceedings before Lord James of Hereford in the last-named year, the leading manufacturers, through their counsel, promised the extirpation of lead poisoning under the rules then proposed; it will be noted, however, that the number of cases per annum remained almost stationary from 1901 to 1908, though it is satisfactory to note a marked decrease in the year 1909.

Distribution of Cases of Lead Poisoning in the five years 1904-1908.

It is evident, therefore, that much still remains to be done, and in order to gauge the position it is material to examine into the record of the 550 potteries which have been placed under Special Rules, and ascertain the number and distribution of the lead poisoning cases for which they have to account.

For this purpose the Committee have taken the period 1904 to 1908 as furnishing the fullest particulars, and they find that during these five years:—

5	potteries	have been	responsible for	75	cases
17	,,	,,	,,	119	,,
151	,,	,,	,,	323	,,
in all 173	,,	,,	,,	517	,,

leaving 377 factories out of the 550 in which no cases have occurred at all. In other

words, 32 per cent. have an average of three cases every five years, while 68 per cent. are entirely free from the disease.

For this anomaly it is not easy to find a satisfactory explanation. In the 173 potteries in which the disease has occurred there are 4,800 workers, as against some 2,000 in the other potteries, and the rate of lead poisoning cases in the latter might have been expected to be in proportion. It is true that many of them are of small dimensions, and their immunity may to some extent be due to this fact, but on the other hand there are several in which the number of workers is quite appreciable.

Lead poisoning is largely to be accounted for by defective conditions of labour, especially when not associated with adequate exhaust draughts, and such conditions necessarily vary in different potteries; but it would appear to be probable that undue pressure of work is also an important factor in producing an outbreak of the disease. In this respect it was shown in the evidence before the Committee that the two largest potteries in which it was most prevalent were both exceptionally busy during the period when the cases occurred; on the other hand one of the largest in which no case was recorded, though otherwise the conditions of labour were by no means good, was conducted in a much more leisurely fashion; it therefore seems that when the amount of work is excessive, either exhaustion or involuntary carelessness on the part of the workers causes them to neglect proper precautions, and the disease is in consequence more likely to be contracted.

The susceptibility of any class of workers to contract lead poisoning is also, without doubt, enhanced by any cause which tends to insufficient nourishment of the physical system, and on this account Dr. Hill in his evidence referred to poverty as predisposing to attacks of plumbism. Sir Thomas Oliver, again, and other witnesses strongly advocated the provision of milk to workers in lead processes before they commence work in the morning, and the necessity for this has been recognised by certain manufacturers who have voluntarily made such provision for years past.

But whatever explanation may be suggested, there is no doubt that this anomaly still exists. In 1908, there were 117 cases reported, which were distributed among the 550 potteries in the following proportions:—

From	3	potteries	- - - - - - -	27 cases
,,	3	other potteries	- - - - - -	10 ,,
,,	16	,,	2 cases each - - - -	32 ,,
,,	48	,,	1 case ,, - - - -	48 ,,
,,	480	,,	no cases - - - - -	—
From	550	potteries	- - - - - - -	117 cases

The peculiar way in which the disease occurs in certain factories and is entirely absent in others is shown by this table in a manner even more striking than by the figures of the five years which have been just reviewed.

Rate of Improvement not maintained.

To revert to the Table of Cases, 1896-1909 (page 8), it is regrettable to note that the rate of improvement, which was considerable up to 1901, was not maintained during the years 1902-8. The annual number of cases remained far below those of 1900 and the preceding years, but showed no tendency to further diminution until 1909. This was the more disappointing in view of the successive introduction in 1901 and 1903 of still more stringent regulations, and it has been suggested that the apparent lack of progress may be due, at least in part, to the introduction of the system of granting compensation to all suffering from lead poisoning contracted in potteries. However this may be, the Committee are of opinion, judging from the potteries visited by them, that it is attributable chiefly to the imperfections in the conditions under which the workers labour, and to the very casual observance which in some is paid both by employers and employed to many of the Special Rules in force. In their view it is more a matter of surprise that under the circumstances the cases of lead poisoning are not far more frequent. Where manufacturers are indifferent to the rules and fail to provide and maintain the safety appliances which the law requires, little blame can be meted out to the workers; but it seems beyond doubt that a considerable number of cases arise directly from the carelessness and indifference of the workers themselves.

There seems, therefore, good reason for anticipating that the rate of improvement will be greatly accelerated if the present Special Rules are amended and strengthened in accordance with the evidence taken by the Committee; it must, of course, depend on whether their strict and continuous observance is in future ensured in every room in each pottery, and the Committee hope to be able to outline a system (see p. 126) which will go far towards attaining this object.

Absorption of Lead into the System.

The manner in which lead is absorbed into the human system is to some extent an open question. The medical witnesses before the Committee were practically agreed that it cannot enter through the unbroken skin. Dr. Russell conceded that it would not do so if the skin were healthy, and Sir Thomas Oliver considered that such a risk would be very slight except with lead salts in solution, a condition in which only traces of them can be found in pottery glazes.

It must, therefore, be either through the alimentary system by the dust being swallowed or through the respiratory system by its being taken into the lungs* that the poison is assimilated, and expert opinion is divided as to which of these channels is the principal mode of entry. Dr. Goadby, who is engaged on a series of systematic experiments in order to determine the point, supported, in company with other witnesses, the theory of lung absorption, and as far as the results of his investigation are available they tend entirely to prove the accuracy of his contention.† Sir Thomas Oliver and other doctors consider that poisoning arises partly from the lead dust which is drawn into the lungs, but mainly from that which adheres to the moist surfaces within the mouth and is subsequently swallowed. From an administrative point of view, it matters but little which theory is correct, since the remedy in both cases—prevention of the inhalation of dust—is the same.‡

Nature of Illness due to Plumbism.

The principal forms which lead poisoning assumes among workers in potteries are:—

Colic and gastric disturbance;
Anæmia;
Paralysis;
Encephalopathy, or affections of the brain.

Fatal Cases of Plumbism.

Only a small proportion of cases prove fatal; the death rate arising therefrom, taking the average of the last 11 completed years (1899 to 1909), has been 1·0 per 1,000 lead workers employed, as will be seen from the details given in the following table:—

Table of Fatal Cases of Plumbism.

	North Staffs District.	Potteries outside North Staffs.	Whole of United Kingdom.	
Number of lead workers employed according to the return for 1907 - - -	5,299	1,566	6,865	
Year.	Deaths.	Deaths.	Deaths.	Death rate per 1,000.
1899 - - - - -	14	3	17	2·46
1900 - - - - -	7	1	8	1·16
1901 - - - - -	2	3	5	0·73
1902 - - - - -	4	1	5	0·73
1903 - - - - -	2	1	3	0·43
1904 - - - - -	4	—	4	0·58
1905 - - - - -	3	—	3	0·43
1906 - - - - -	4	—	4	0·58
1907 - - - - -	8	1	9	1·30
1908 - - - - -	11	1	12	1·74
1909 - - - - -	5	—	5	0·73

* See extract from a treatise on lead poisoning, by Dr. Goadby; Appendix XXIV. of this Report.
† See Appendix XXV.
‡ In this connection, see also remarks concerning dippers of Jet and Rockingham ware, page 68.

How the death rates above set forth compare with those due to accidents, etc., in the hazardous branches of other occupations, the Committee are unable to determine, as the returns of employment are not as a rule subdivided for groups of workers exposed to varying risks. This being the case, the only comparison possible is as between one trade as a whole and another, and on this basis the death rate from plumbism among potters is but slight compared with that from accidents, etc., in other dangerous occupations.

The Committee are of opinion that if in future the employment returns could be subdivided for hazardous and non-hazardous branches of different industries the information would be extremely valuable.

Variation in Severity of Attacks.

For the purposes of comparison the cases of lead poisoning occurring during the years 1903-7 were specially classified by Dr. Legge, H.M. Medical Inspector of Factories, and the attacks were found to vary greatly in duration and severity.

In these five years there were 217 cases among males and 280 among females, and the results of the classification according to severity are as follows:—

	Males.		Females.	
	Cases.	Per cent.	Cases.	Per cent.
Severe - - - - - - -	42	19·3	35	12·5
Moderate - - - - - - -	97	44·7	97	34·6
Slight - - - - - - -	77	35·5	144	51·4
Not stated - - - - - - -	1	0·5	4	1·4
Total - - - - -	217		280	

Cases are in general reported as "slight" when the symptoms are confined to:—

(1) Colic without complications and of short duration;
(2) Anæmia in adolescence aggravated by employment.

"Moderate" cases include those in which the leading symptoms are:—

(1) A combination of colic with anæmia;
(2) Profound anæmia apparently without complications;
(3) Slight muscular paresis; *i.e.*, incipient paralysis.

"Severe" cases include those showing:—

(1) Marked paralysis, such as total wrist drop;
(2) Encephalopathic conditions, such as convulsions; optic neuritis, that is, loss of sight, temporary or complete; and mental affections.

Recovery in Non-fatal Cases.

In the milder cases of lead poisoning the sufferers appear to recover completely, but, taking all degrees of severity together, there is no system of collecting reports showing the length of time which it takes a patient to recover from an attack. Dr. Legge, in the Annual Report of the Chief Inspector of Factories for 1905, page 399, quotes particulars regarding 395 attacks in Prussia, the average duration of which is about three weeks; it is, however, impossible to say how far this may be taken as a guide in estimating the average duration of cases in England in the absence of any definite statistics bearing on the subject.

Recovery from wrist drop must always be a matter of months, if not years; and in all cases the length of the period before recovery is, broadly speaking, proportionate to the severity of the attack. The Committee think that most valuable information would be obtained if a system were established for putting on record and tabulating the duration of all cases of poisoning due to industrial causes.

General Impairment of Health by Work in Lead Processes.

In addition to the actual tabulated cases of plumbism, the evidence tends to show that the general health of many operatives is impaired, though not to an extent sufficient to give rise to definite symptoms of lead poisoning.

The poison is frequently cumulative in its action, and a person not suffering

from an attack may be on the very verge of one owing to the amount of lead in his system; under such conditions exposure to a very small extra quantity would suffice to bring on a definite seizure, and acute symptoms might develop very rapidly.

Susceptibility to lead poison is to a certain extent a matter of individual idiosyncrasy, and a good illustration of this is to be found in epidemics arising from the pollution by lead of a water supply; a whole town may drink such water and only a few suffer serious ill effects.*

Workers in potteries are no doubt affected in a similar manner by contact with lead. Unless this were so, it would inevitably happen that where one developed an attack of plumbism all others engaged on the same process would suffer equally, and presumably, therefore, only those contract the disease who are by nature prone to it. Liability, however, to the disease must be increased by carelessness in the observance of proper precautions.

The Committee are, therefore, of opinion that, while the difference of susceptibility is the most important factor in determining the occurrence of lead poisoning in particular cases, attention must also be called to the habits and practices of some of the workers themselves as contributory causes.

The medical witnesses, although expressing their opinion in different words, generally agreed that the inhalation of lead dust to a sufficient extent to produce an apparent effect, brings about pathological changes in the blood and the arterial system, which undermine the health of those so affected; since, moreover, such dust must, if in the air, be absorbed, the great majority were strongly of opinion that all, or nearly all, lead workers have lead in their system.

Many of these witnesses also spoke of women as being more susceptible to lead poisoning than men; this view is supported by the general statistics of lead poisoning,† fatal and non-fatal cases taken together, among workers in earthenware and china works; but the death rate from lead poisoning among women is slightly less than that among men.‡

Evidence given by some of the doctors examined, showed that miscarriages are abnormally frequent among married women lead workers; one or two witnesses even believed that work in a lead process before marriage might afterwards conduce to miscarriage, and both of these opinions received some confirmation from a special inquiry subsequently conducted by Dr. Reid, a member of the Committee.§ In any case there seems no doubt that in women lead poison is productive of specially serious consequences.

Lead Poisoning due more to Lead in Glaze than to Lead in Colours.

Use of Lead in Colours.

In the decoration of pottery some colours are employed which contain lead. They are, however, mainly applied in the form of paint, and as such are mixed with oil or some similar medium; they do not, therefore, give rise to any dust, and no cases of lead poisoning are recorded as attributable to contact with them. The work of handling them has consequently never been scheduled as dangerous.

There are, however, certain decorative processes which are so scheduled, owing to the fact that they entail the use, either in a dry state or in the form of spray, of colours which contain lead. These consist of ground laying, colour dusting, aerography, and the manufacture of lithographic transfers, all of which are fully dealt with on pages 88, 90 and 93 of this report.

Comparison of Lead Poisoning cases due respectively to the handling of Glaze or Colours.

The Committee believe that in each of these processes the risk involved can be obviated by the use of efficient exhaust draughts, but the handling of such colours has caused a certain amount of lead poisoning in the past. The number of cases,

* At the same time, of course, due regard must be had to the varying consumption of leaded water, and the varying proportion of lead in different samples of water from the same pipe or from pipes of different lengths, but cases of injury have been recorded where the proportion of lead has been as small as 1-50th or even 1-100th of a grain per gallon.

† See Appendix VII. ‡ See Appendix X.

§ See Dr. Reid's evidence, Questions 15665 to 15904, and the tables embodying the results of his investigations, Appendix LII.; also page 115 of this Report.

however, directly attributable to it are few in comparison with those traceable to the use of lead in glaze, as shown in the following table:—

Year.	Lead cases in			Total.
	Glaze Processes.	Decorative Processes.	Unclassified.	
1901 - - - - -	97	6	3	106
1902 - - - - -	78	7	2	87
1903 - - - - -	84	8	5	97
1904 - - - - -	99	3	4	106
1905 - - - - -	78	4	2	84
1906 - - - - -	98	9	–	107
1907 - - - - -	90	8	5	103
1908 - - - - -	106	6	5	117
1909 - - - - -	58	–	–	58
Total - - -	788	51	26	865
No. of persons employed (1907) - - - -	5,695	711	459	6,865
Average annual attack rate per 1,000 employed -	15	8	6	13·7

From these figures it is obvious that the consideration of a possible substitute for lead in glaze is much more important than the corresponding question relating to colours used for purposes of decoration.

LEADLESS GLAZE.

Substitution of Other Materials for Lead in Glazes.

The Committee are asked to inquire into the possibility of substituting other materials for lead in the manufacture of pottery glazes, and without doubt the abolition of its use is very desirable in that, without it, the need for special precautions against lead poisoning would largely disappear. But this is no new question; in 1820 the Society of Arts awarded a medal for the discovery of what was then supposed to be a satisfactory leadless glaze* for pottery, and in the evidence given before this Committee it was pointed out that efforts to attain this object have extended over the last 40 years. Nevertheless, up to the present moment it is affirmed by many manufacturers that lead still remains the only substance with which they can produce a perfectly glazed and marketable article.

Previous Inquiries regarding Leadless Glaze.

In order to present this subject in a complete form, it will be as well in the first place briefly to quote the results of previous inquiries relating to it.

Committee of Inquiry, 1893.

The first Committee on Potteries was appointed in 1893, and their conclusion as to the possibility of finding a substitute for lead in glaze reads as follows:—

> "After carefully considering the evidence before us, we do not see any immediate prospect of such glazes becoming universally applicable to pottery manufacture."†

Inquiry by Dr. Thorpe and Dr. Oliver, 1898–9.

The next investigation into this subject was made by Dr. Thorpe and Dr. Oliver, who were appointed on 7th May, 1898, by the Home Secretary, Sir Matthew White Ridley, Bart., to inquire into the hygienic question involved in the use of lead in pottery processes.

* This is the name that has been popularly adopted for a glaze in the preparation of which no lead has been used.

† Report of Potteries Committee, 1893, C. 7240.

They pursued their investigations for ten months, in the North Staffordshire Potteries, and in Holland, Belgium, Denmark, Sweden and Germany; on 21st February, 1899, they issued their Report*, a substantial portion of which was devoted to setting forth the case for leadless glazes. In paragraph 11 they make the following statement:—

"The conclusions at which we arrive from the inquiries we have instituted at home and abroad, and from the observations and experiments we have made, are:—

"1. That by far the greater amount of earthenware of the class already specified [viz., all kinds of table, domestic, and sanitary ware; china furniture and electrical fittings; white, cream, buff, and printed tiles], can be glazed without the use of lead in any form. It has been demonstrated, without the slightest doubt, that the ware so made is in no respects inferior to that coated with lead glaze. There seems no reason, therefore, why in the manufacture of this class of goods the operatives should still continue to be exposed to the evils which the use of lead glaze entails.

"2. There are, however, certain branches of the pottery industry in which it would be more difficult to dispense with the use of lead compounds. . . . ."

Evidence Taken by the Present Committee Regarding Leadless Glaze.

The present Committee have considered very fully this part of their inquiry, and every firm which was known to make a speciality of leadless glazed ware, was asked to send a representative to give evidence. All except one of the firms in question responded to the invitation, and submitted to the Committee details of their experience with leadless glazes during the ten years which have elapsed since the publication of the report by Dr. Thorpe and Dr. Oliver above quoted.

The witnesses who were heard by the Committee respecting the use of glazes free from lead, included 20 who are experienced in the manufacture of pottery, 8 concerned with the buying of earthenware and china on a large scale, and 16 medical men and others.

Evidence of Dr. T. E. Thorpe (now Sir Edward Thorpe).

Dr. Thorpe, in the course of his evidence before the Committee, expressed his complete adherence to the conclusions set forth in the Report of 1899, just quoted. The difference in the constitution of the various bodies used in the manufacture of pottery, he regards as of slight consequence; in his opinion the introduction of leadless glazes is practicable for a great bulk of white and cream coloured ware, and is the only means of securing entire immunity from plumbism among the workers.

Manufacturers entirely successful with Leadless Glaze.

Of all the manufacturers examined, only two, Mr. Heath, of James Reeves and Co. and Mr. Horn, of Horn Bros., told the Committee that they were entirely successful in using leadless glazes for the whole of their output.

The ware manufactured by both these firms is of common quality, and the witnesses admitted frankly that it could not be compared with the highest grade production of British potteries. Both find that they can get a good gloss and bright colours without the use of lead, and their present glaze is much cheaper than the lead glaze they formerly used. They export a large part of their ware to India, Africa, etc., and find that it competes successfully in those markets with lead glazed ware, both British and foreign; they have no difficulty with regard to maintaining a high proportion of saleable ware from the glost† oven, and they have no trouble with crazing.‡ On the other hand, their ware is admittedly of the cheapest kind, and not subject to any particular selection.

James Reeves and Co., Fenton, Staffs.—Mr. Heath, a member of this firm,

* Report on Lead Compounds in Pottery, 1899, C. 9207.

† In the glost oven the ware is fired, with its coating of glaze, and comes out as fully glazed earthenware or china; it is then ready for sale unless special decoration, *e.g.*, gilding, is required.

‡ *i.e.*, the appearance of a fine network of cracks on the surface of the glaze, a defect which sometimes becomes apparent at once, sometimes not until months after the ware is finished.

stated that they have exclusively made leadless glazed earthenware for the last ten years, and found it to compete successfully in the open markets both with English and foreign lead glazed ware.

He considers leadless glaze to be superior to raw lead* glaze for the following reasons:—

(1) The materials for making it are from $12\frac{1}{2}$ to 20 per cent. cheaper.

(2) With care in firing there is practically no loss in "seconds†," in any case the percentage of "seconds" is less, and the cost of the finished glazed article about 25 per cent. less than that of lead glazed ware.

(3) It produces brighter colours than lead glaze.

(4) With leadless glaze there have been no complaints of crazing, though there used to be with lead glaze.

The ware which the firm makes is principally intended for foreign markets, and the most important part of their output is a variety known in the trade as "Persian painted." It is a very cheap class of pottery competing with German productions in the Indian and other markets, and consists of rice bowls, cover bowls, soup plates, flat plates, jugs, mugs, toilet ware, dinner services, and almost all forms of common earthenware; in its manufacture the use of leadless glaze is very satisfactory both in appearance and every other respect.

Mr. Heath admitted that this class of goods could not be compared with the highest grade productions of British potteries; he sends a small quantity of ware to Canada, but none to the United States of America, or to the Continent of Europe.

Horn Bros., Ferrybridge, Yorkshire.—Mr. Horn, a member of this firm, stated that their manufactures consist of ordinary dinner services, toilet ware, and all kinds of common Yorkshire ware. They export to India, Africa, and the West Indies, competing in these markets with several Staffordshire and Yorkshire firms. They find leadless glaze is more economical to work, and have made use of it since February, 1901.

Since taking up leadless glaze they have lost no customers, and Mr. Horn considers that they have been quite successful in competition. He stated that with lead glaze they used to have a great deal of crazed ware, but now never find any, and that consequently they get fewer "seconds"; he was of opinion that they would have had more complaints if they had not adopted a leadless glaze.

Mr. Horn admitted quite frankly that he did not compete in the least with the high grade wares made in Staffordshire.

Experience of other Manufacturers.

The experience of other manufacturers has not been so fortunate. They admit that the actual cost of the materials used for leadless glaze is approximately the same as, or slightly less than, that of those required for a glaze made with lead, but among other disadvantages they have found that the loss in "seconds" is greater with ware dipped in the former, and consequently militates strongly against its commercial success.

Worcester Royal Porcelain Company, Ltd.—Mr. Evans, managing director of the Worcester Royal Porcelain Works, produced samples of the high-class ware made by his firm; he stated that no lead has been used by them in the glazing of china since 1900, but that they have not been able to make their semi-porcelain successfully without lead. In his opinion, the use of leadless glaze for the Worcester china raised the cost of manufacture by about 10 per cent., by reason of the additional loss in "seconds," but added that his firm could afford to bear this increase in the cost of production, because of the excellent prices which the high reputation of the Worcester ware enables them to command.

Josiah Wedgwood & Sons, Ltd., Etruria, Staffs.—Mr. Lawrence Wedgwood stated that his firm first added china to the other classes of pottery manufactured by them about the year 1812; they ceased making it in 1815, and recommenced

* "Raw" lead is an expression commonly used to denote a lead compound—such as the carbonate, *i.e.*, white lead, or one of the oxides, *i.e.*, red lead or litharge—which is added to the glaze direct, that is to say without being previously fritted and so converted into a silicate.

† Pieces not of first-rate finish, which, consequently, cannot be sold at the full market price.

in 1878. When the new branch for china-making was started in 1878, the glaze adopted for this class of ware was leadless, and they persevered with it for 14 years. They did not, however, find it quite satisfactory; it failed to show a sufficient range of elasticity, that is to say, it would not adapt itself to the rate of shrinkage of the other materials used; with leadless glaze, moreover, the gold had a tendency to peel off the edges, and enamel colours were not sufficiently bright; they therefore discontinued making any use of it in 1892.

Mr. Wedgwood also mentioned that Mr. Wilton Rix, an expert chemist who had carefully studied the problems connected with the use of lead in pottery glazes, was employed by his firm for 2 or 2½ years after 1892, to make experiments with leadless glazes, but was not successful; he further pointed out that they have always glazed their Jasper ware inside with a leadless glaze, but the body of that ware is a special one not manufactured by any other firm.

E. Hughes & Co., Fenton, Staffs.—This firm only manufacture china of a cheap to medium quality. Mr. Massey, a member of the firm, produced samples showing the kind of ware made, and gave evidence to the effect that they used no lead from 1901 to 1908, but abandoned leadless glaze in 1908 because of the loss in "seconds," which amounted to 7 or 8 per cent. more than with lead glaze. He added that if they advanced their prices, they could not maintain their market in competition with lead glazed goods.

Carter & Co., Poole, Dorset.—Mr. Owen Carter stated that about 5 per cent. of the firm's total output, consisting of tiles and faience, was made with leadless glaze, and produced samples of the former showing the beautiful and artistic results that can be so obtained.

The firm first used leadless glazes for lustre ware in 1893, and for tiles in 1899. The witness personally considered the effects thus secured were finer than those obtained with a lead glaze, but the two are not really capable of comparison, and to substitute the one for the other without buyers knowing the difference, he stated to be impossible. Certain colours can be produced with lead glazes, but not with leadless, and *vice versa*, and, according to the firm's experience, ware dipped in the one has a different texture to that dipped in the other. With regard to the proportion of ware that can respectively be obtained of good quality, Mr. Carter maintained that if due allowance were made for their being distinct in kind, and their standards of perfection being therefore also distinct, the leadless glaze would compare favourably with the leaded.

Mr. Carter further submitted that the defects of leadless glaze were as follows:—

(*a*) A greater tendency to crazing.
(*b*) A greater difficulty in obtaining uniformity.
(*c*) Frequency of accidental defects.
(*d*) Tendency to opalinity.
(*e*) More limited palette, in that some colours, notably warm rich tones, cannot be made without lead.

"Speaking generally," he added, "the leadless colours are colder, but there is a lot of life and brilliancy about them. The tame muddy flatness that is sometimes seen in the lead glazes, is hardly ever seen with leadless colours. Much of the life and charm is doubtless owing to crazing, the variation, the flecks of opalinity, and the fact that no two tiles are exactly alike. There is no doubt that most beautiful work can be done in the leadless glazes, but the trouble comes when orders are obtained for quantities of certain definite colours to sample. It is in vain to explain that the network of crazes is beautiful, breaks up the light and gives depth, or that the variety and accidental opaline effects give the tiling interest: one is met by the reply that a certain definite article is required and must be supplied." Mr. Carter finds it impossible to supply such a definite article with leadless glaze; and concludes his evidence with the admission that leadless glaze in his hands has been an æsthetic rather than a commercial success.

Pountney & Co., Ltd., Bristol.—Mr. T. B. Johnston, managing director of this firm, said that their output embraces all varieties of general earthenware. For part of this, including some of their common and medium qualities but none of their highest class ware, they have used leadless glaze since 1903, the materials for which he stated to be rather cheaper than those required for lead glaze.

Compared with lead glazed goods, the ware in question appeared to show no greater proportion of "seconds." The evidence, however, on this point was not conclusive; the firm are now working in a new factory, which offers special advantages, and it was therefore to be expected that such "seconds" would be less numerous; on the other hand, the selection is considerably stricter than it used to be, that is to say, some of the articles which would in former years have been passed as of first-rate quality are now not so treated.

Mr. Johnston has never had any complaints of the ware crazing; in durability he considers it in no way inferior, but in appearance to have less sparkle. Lead glazed goods seen in bulk in a shop window, he stated, would be more attractive to the public, but there is no perceptible difference when the articles are seen on a table.

Keeling & Co., Ltd., Burslem.—Mr. Joseph Keeling stated that, since 1900, his firm have manufactured a certain quantity of leadless glazed ware; that it consists of general earthenware such as dinner, toilet, tea and kitchen ware, and is made by his firm only for the home market. In his opinion it is in appearance much inferior to lead glazed, and is only supplied when a customer insists on having it. He mentioned that the loss in "seconds" was very great. In respect of its durability there has been no complaint, but the glaze is dull and lacks brilliancy, and while being fired, has very little flowing power. His firm have made no further attempt to improve their leadless glaze since 1903, their reason being that they possess an exceedingly good low solubility glaze (see page 30), which they have considered, in so far as the health of the workers is concerned, to be quite satisfactory.

C. T. Maling & Sons, Newcastle-on-Tyne.—Mr. C. T. Maling stated that his firm first tried leadless glaze in 1870 for the manufacture of jam pots. At the time it met with no success, but since 1899, when a second attempt was made, they have used it for this purpose without intermission. For common articles of this description it is quite satisfactory, and cheaper than lead glaze; but it has a rough surface and in appearance is very shabby and dull. It is not, therefore, suitable for better classes of pottery such as dinner services and toilet ware.

They discontinued the use of it for general earthenware in 1904. The original formula for its composition in 1899 was frequently improved up to 1906, but not since that date. Their experience is that nobody will buy high-class ware made with leadless glaze, but it was admitted that, in the case of dinner ware, they had only given it about one year's trial.

Blair & Co., Longton.—Mr. Woolley, a member of the firm, stated that they only manufacture china, and that one of their specialities is ware which is ornamented with printed patterns before the application of the glaze—a method known as under-glaze decoration. With a view to saving the expense, incidental to the rules proposed by the Home Office, of putting in exhaust fans and of providing for periodical examinations by the Certifying Surgeon, the firm made trials of leadless glaze for a period of six months. These were at first, on a small scale, fairly successful, but as soon as the ware was introduced into the oven in bulk the glaze became dull.

Such ware was consequently unsaleable; about a third of the firm's trade is on the Continent, principally with Germany, Austria and France, and they find that without lead they cannot get colours of the necessary brilliancy. Pieces, if at all dull, are returned to them, and Mr. Woolley considered that the prohibition of lead would at once do away with a third of their trade.

Doulton & Co., Ltd., Lambeth.—Mr. Thomason, chemist to this firm at Lambeth, considers that leadless glaze involves great mechanical difficulties. It could be used if buyers would accept a lower standard, or, if they were willing to pay a higher price, the higher grade of plain china could be made with it. As a general proposition he does not consider its use to be practicable.

Doulton & Co., Ltd., Burslem.—Mr. J. C. Bailey, general manager to the firm, and chairman of the Staffordshire Potteries Manufacturers' Association, stated that at one of their potteries, which is devoted to the manufacture of insulators and

sanitary goods, his firm are using leadless glaze for a portion of the ware which is made there. They have constantly tried it in their general earthenware and china works, and book orders for goods so made whenever it is specially demanded. He does not, however, consider it to be suitable for the bulk of such ware as made by his firm.

Bishop & Stonier, Hanley.—Mr. D. F. W. Bishop, manager of this firm, stated that they manufacture both earthenware and china in addition to a special class of ware which has a lemon-coloured glaze and is known as oriental ivory. They have made one or two attempts to use leadless glaze, the last being as lately as 1908, but with very unsatisfactory results.

Alfred Meakin, Ltd., Tunstall.—Messrs. Alfred Meakin, Ltd., manufacture high grade earthenware largely for America. Their chemist, Mr. Jackson, stated that they have made several experiments with leadless glaze since 1903, including one within the last two years, but have never been successful.

Johnson Bros. (Hanley), Ltd., Hanley & Tunstall.—Mr. H. J. Johnson, a director of the firm, stated that they are probably the largest manufacturers of earthenware in the world; their production is of a high grade, and a large proportion of it goes to the American market. His firm persevered with trials for leadless glazes for some time until the year 1903, and lost many hundreds of pounds to no purpose. They employed the best expert they could get for 38 months, who was solely engaged in trying to obtain a satisfactory leadless glaze or a glaze of low solubility, but after this length of time the firm thought themselves justified in abandoning experiments.

Pilkington's Tile and Pottery Co., Ltd., Clifton Junction.—Mr. Joseph Burton, works manager, is a highly qualified chemist. He stated that at the Clifton Junction works they make tiles and artistic pottery, and for certain of the articles use leadless glazes; they do not, however, find such glazes suitable for the bulk of their output.

Macintyre & Co., Ltd., Burslem.—Mr. Watkin, managing director of this firm, was also authorised to speak for other firms belonging to the same branch of the trade, among whom were included:—

Bullers, Ltd., Hanley.
Taylor, Tunnicliff & Co., Ltd., Hanley.
Gaskell & Grocott, Longport, Burslem.
Wm. Wood & Co., Burslem.

The class of goods made by these firms is of a very miscellaneous character, and Mr. Watkin enumerated the following varieties as samples, namely:—

> China door furniture, japanners' fittings, brassfounders' fittings, plumbers' fittings, silver platers' goods, stationers' sundries, steam gauge dials, thermometer and dairy scales, photographic apparatus, electrical accessories, and advertising sundries.

For all varieties of goods, leadless glaze is used wherever practicable, and constant experiments are made with a view to increasing their number; in the witness's opinion, however, it is not suitable for the bulk of the output of these firms, inasmuch as articles of first-rate quality and finish are liable to an undue loss in "seconds."

Ridgways, Hanley.—Mr. John Ridgway, senior partner in this firm, stated that they do a large export as well as home trade in earthenware of a first-rate quality. They have not themselves attempted to use leadless glaze; Mr. Ridgway has, however, seen several trials made with it, but never anything that would at all suit his firm's requirements.

Evidence of Dr. Mellor.

Dr. J. W. Mellor has been since 1904 instructor in pottery manufacture under the Staffordshire County Council. He stated that a committee of manufacturers, some time ago, offered his students a prize for the best research work with

regard to leadless glaze, and, the better to cover the ground, he has divided the subject up into several sections, devoted to different chemical points connected with it; the work was started two years ago and is still in progress, but he is not very sanguine of success in finding a substitute for lead; he admitted that eventually certain combinations might be found to imitate its effects sufficiently to answer specific purposes, but was of opinion that nothing could be found to behave exactly in the same way.

Evidence of Mr. William Burton, M.A., F.C.S., a Member of the Committee.

Mr. William Burton said that he had given most careful consideration to the question of drawing up a schedule of those articles which can be made with leadless glaze, but had not been able to compile any that he could recommend. He emphasized the fact that, in his opinion, there is no substance with the same excellent properties as the compounds of lead for making suitable glazes to be fired at a moderate heat.

Mr. Burton stated that he is continuously experimenting with leadless glaze. He takes advantage of some of its defects to produce as beautiful ornamental articles as have ever been made in pottery; but for the manufacture of ordinary table ware he does not consider it satisfactory.

Scottish Stone Ware Potters.

H. Kennedy & Sons, Barrowfield, Glasgow.—Mr. Joseph Kennedy stated that, so far as he knew, no lead has been used in stone ware glazes for the last 12 years.

Caledonian Pottery Co., Ltd., Rutherglen, Glasgow.—Mr. Service, a member of the firm, stated that one department in their works at Rutherglen is devoted to stone ware, in respect of which he confirmed Mr. Kennedy's evidence.

Evidence of Buyers of Pottery.

In addition to taking the evidence of manufacturers, the Committee also examined witnesses who could speak from the buyer's point of view.

In 1899 an official communication was sent by the Home Office to other Government Departments, impressing on them the desirability, in the interests of pottery workers, of only using leadless glazed ware, and the Committee heard evidence from representatives of the buying departments of the following public offices:—

(1) Metropolitan Police Department.
(2) Prison Commission.
(3) H.M. Office of Works.
(4) Admiralty.
(5) War Office.
(6) Post Office, Telegraph Department.

Metropolitan Police Department.—Mr. Everest, Chief Clerk to the Receiver for the Metropolitan Police District, said that all the ware purchased by them since 1900 was made with leadless glaze. It was all of an ordinary class, tea and dinner services, fireclay sanitary goods, glazed bricks, tiles, etc. All supplies are bought through middlemen, and all that is required is that the goods should be sound and strong. With their quality and durability Mr. Everest expressed himself as quite content; with the price he was also satisfied, but this he could not compare with that paid previous to 1900, as the pattern of their general earthenware, *i.e.*, a plain white ground ornamented with a blue line and the letters "M.P." in the form of a badge, was first adopted in that year.

Prison Commission.—Mr. Juleff, speaking for this department, also said that they buy through middlemen, and have stipulated for leadless glazed ware since 1901. The ware they require, according to samples produced by Mr. Juleff, is not of a high-class finish, and includes "dinner plates, dishes of various sorts, pint mugs and chamber services, and articles for hospital use, such as bed-pans." It is supplied direct to the prisons, and found to be quite satisfactory in quality and durability; the prices averaged about 10 per cent. more than were paid prior to 1901 for lead glazed

goods. The Committee were struck by the inferior quality of the ware accepted by this Department.

H.M. Office of Works.—Mr. Hillier, Controller of Supplies in H.M. Office of Works, stated that his Department bought only leadless glazed ware from 1900 to 1906, and that their purchases included both general earthenware and china, though more of the former. The articles consisted mainly of tea-cups, saucers and plates; they were found to be satisfactory in durability and other requirements, but there was a difficulty in obtaining tenders; in 1906 only one firm could be induced to submit quotations, and the lack of competition resulted in enhanced prices; the contracts have in consequence been thrown open to ware made with a low solubility glaze (see page 37), in order to secure lower prices.

Mr. Hillier, for the guidance of the Committee, gave quotations for pottery dipped respectively in leadless and low solubility glazes, as compared with the prices previously paid for similar ware purchased without any restrictions as to the use of lead; he has further, since giving evidence, written to say that H.M. Office of Works have held an open competition for leadless glazed goods, and have thereby been enabled to place contracts for them, especially in the case of china, at much more favourable rates. It would therefore appear that it is now possible to obtain leadless glazed china in bulk without paying for a specially high-priced variety.

Admiralty.—Mr. F. W. Black, C.B., Director of Navy Contracts, said that the Admiralty dealt direct with manufacturers; from 1901-1905 leadless glazed ware was exclusively purchased, but the prices were from 10 per cent. to 15 per cent. higher than those previously paid. Of the durability of the ware there had been no complaints, but in respect of its general quality the reports were conflicting, some being favourable, others the reverse. After 1905 the contracts were again thrown open to lead glazed goods, because they understood that the Home Office, in view of Lord James's award (see page 27), were not attaching so much importance to the use of leadless glaze, although no official communication was received from the Home Office on this point.

Since that date there has been no stipulation as to the amount of lead to be used*, but from inquiries made in 1908, the Admiralty believe that a large quantity of the ware at present being supplied to them is made with a glaze of low solubility.

Mr. Underhill, Inspector of Victualling Stores, said the leadless glazed ware supplied to the Navy in 1901 to 1905 was most unsatisfactory—there was delay in delivery and the general appearance of the ware was not so good; the glaze was rough; the prices averaged 15 to 20 per cent. higher than for lead glazed ware; and no rejections were allowed. They had some samples sent them of a very perfect leadless glazed ware, but the price of that was prohibitive.

Two classes of ware are needed for the Navy, viz., common basins and plates for seamen and better ware for officers' use; for the former Mr. Underhill thought it would be possible to stipulate that only leadless glaze should be used, but not for the higher-class ware.

War Office.—Lieut.-Col. Moore-Lane, Chief Inspector of General Stores at Woolwich, stated that he had to deal, generally, with articles of domestic use, such as china tea and breakfast services, earthenware dinner services, articles for hospital use and general purposes, as well as Rockingham tea and coffee pots, stoneware jars foot-warmers, and bottles of various sorts. These are principally bought from manufacturers direct.

He said that from 1899 onwards for some five years leadless glazed ware was purchased exclusively: with the commoner articles there was not much fault to find, but in regard to the better class goods for table use, a certain number of complaints were received from the Service on the ground that they lacked finish, and were otherwise defective. They were reported not to wear well, to discolour readily, and to crack if subjected to heat.

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* Except as regards sanitary ware, which the Admiralty have continued throughout to require to be made without lead.

Col. Moore-Lane further stated that it was apparently difficult to maintain the quality desired, and rejections were numerous. This is a question of considerable importance, as officers have to pay a certain rent for mess crockery, and therefore expect it to be as good as that to which they are accustomed.

The lead glazed ware, at present provided, gives satisfaction, and a lower standard of finish would not be acceptable. The question of expense has also to be considered.

Post Office, Telegraph Department.—Mr. Hartnell gave evidence with regard to electrical insulators used by the Post Office, the purport of his evidence being briefly that the white leadless insulators, which were tried in former years, gave, under certain circumstances, a less perfect insulation; those recently purchased show a much better finish, are quite as good as those glazed with lead so far as can be judged at present, and are no more costly; the question of their durability is inevitably an open one in the meantime, as the perfecting of the leadless glaze is only a recent advance and sufficient time has not yet elapsed to allow a proper estimate of its wearing qualities to be formed. Brown insulators coated with a leadless salt glaze have been found even more efficient than the white specimens which are prepared with a lead glaze.

Evidence of Mr. Minton Goode.

Mr. Minton Goode, of the firm of Thos. Goode and Sons, South Audley Street, London, W., retailers of pottery in a large way of business, stated that they have sold leadless glazed ware for about 10 years; it is more expensive than lead glazed ware, the prices averaging about 10 per cent. higher, and with regard to durability he does not think it has had a sufficiently long trial to justify him in giving a guarantee. Of the appearance of the ware no complaints have been received, but so far none of their best services have been made with the leadless glaze. The public he considers to be apathetie in the matter, and to show no marked preference for ware made without lead.

An important part of Messrs. Goode's business consists in matching old services. The reproduction must be precisely the same as the original; this result cannot be obtained at present with leadless glaze, and if manufacturers were to overcome this difficulty they would demand a higher price.

Practicability of Issuing a Schedule of Articles to be made without Lead.

In view of the above evidence, it was suggested to the Committee that a schedule of articles should be drawn up in the manufacture of which the use of lead should be prohibited, and the proposal received most careful consideration.

Advantages of such a Schedule.

The advantages of such a schedule, if it were practicable, are obvious. In those factories in which only articles included in it are made, the risk of lead poisoning connected with glazing processes would be entirely removed. The schedule, moreover, if experiments led to the composition of more perfect types of leadless glaze, would without doubt be constantly capable of expansion, and it is fair to assume that eventually in many potteries detailed regulations for the prevention of lead poisoning would become obsolete, and any such solution of the problem must necessarily be the most simple and the most complete.

*List of Articles drawn up by Dr. Thorpe.**

In the course of his evidence, Dr. Thorpe was asked to give a list of those articles for the production of which no lead was in his opinion required. It included

* See Dr. Thorpe's answer to Question 11242. (Also see page 13.)

many varieties of ordinary ware for household use, such as table, domestic and sanitary ware; china furniture and electrical fittings; white, cream, buff and printed tiles.

Opposition of Manufacturers to the proposed Schedule.

The manufacturers, on the other hand, were entirely opposed to the adoption of any such proposal. Much evidence, strongly condemning the plan, was given before the Committee by employers in various branches of the trade, and at a conference held by the Chairman at Stoke-on-Trent on the 14th July, 1909, many of the leading manufacturers of china furniture and electrical fittings spoke to the same effect. The various arguments urged against the proposal may be summarised as follows:—

1. Manufacturing difficulties.

2. Competition of foreign-made ware in the home market.

3. Competition of British manufactures with foreign goods in foreign markets.

4. Customers' requirements.

1. *Manufacturing difficulties.*—In the majority of cases it would be of little practical value to prohibit the use of lead for certain articles, and at the same time allow workers engaged in their production to be exposed to the risk of lead poisoning due to the manufacture of other articles glazed with lead in the same room. Any such prohibition, therefore, to be effective, would have to be supplemented by a regulation forbidding the manufacture of scheduled articles in places where lead is being handled, and any such regulation, it was pointed out, would involve insurmountable manufacturing difficulties. Many of the most important potteries are already built in on all sides, and are much inconvenienced by the impossibility of extending their areas; if firms so situated are required to erect a separate dipping house, ware cleaning place, and glost placing shop for the small part of their output included in the schedule, it is probable that they would have to abandon that part of their business.

A further manufacturing difficulty arises in connection with the manufacture of leadless glazed ware in bulk. As long as it is being made side by side with a considerable proportion of lead glazed ware, it can be fired in the most suitable position in the oven, and in this way it is found possible to get a satisfactory proportion of it of good quality; if, however, an oven has to be filled entirely with such ware, manufacturers state that a large percentage is likely to come out bad.

2. *Competition of foreign-made ware in the home market.*—(*a*) Without lead in its composition, it will be remembered that the behaviour of glaze is more difficult, and the loss by seconds greater; if, therefore, the use of lead were prohibited, all articles that might be scheduled, except those of the commonest kind, would either have to be manufactured at a lower standard of quality, or at an increased cost, and in consequence it would be manifestly unfair to permit the competition of similar foreign ware, the materials of which were not subjected to the same restrictions.

To meet this difficulty it would no doubt be possible, by providing the Customs with a simple method of testing the presence of lead, to prevent the importation of ware in which it might be discovered; the Committee are not, however, in a position to judge whether such a policy would involve insuperable difficulties.

(*b*) But even if such a policy were feasible, there is yet another point to be considered. In certain classes of ware, notably such as is translucent, *e.g.*, china and porcelain, the bodies used respectively by British and Continental potters are radically different in composition. In English china-ware there is a large pro-

portion of calcined bone,* which is absent from foreign porcelain; the two methods of manufacture are, in consequence, widely different; the Continental variety is fired to so high a temperature that a leadless glaze of a special type can be employed; when so treated, it is in fact even more readily glazed without lead than with it, and competes to some extent with bone china glazed with lead.

In this respect Mr. S. L. Plant† stated that in many of the most paying lines, the latter ware is being driven out of both English and foreign markets. It is clear, therefore, that bone china, which when dipped in a lead glaze meets with serious competition from foreign hard-paste porcelain, will be still further handicapped if it is made compulsory to use leadless glazes in its production, while, on the other hand, inasmuch as the hard-paste ware is made without lead, the prohibition of the importation of lead glazed ware would afford no protection. Under these circumstances, it might be supposed that hard-paste bodies could with advantage be adopted in English potteries, and the point was raised by the Committee. Mr. Ridgway, Mr. Plant, Mr. Bailey,‡ Mr. William Burton and Mr. Joseph Burton,§ all emphasised the fact that any such attempt to imitate foreign porcelain could only end in disaster.||

3. *Competition of British manufactures with foreign goods in foreign markets.*—The prohibition of the use of lead would also handicap British potters unfairly in competition with those abroad in respect of articles intended for foreign markets. It would, no doubt, place them on a more equal footing if the restriction could be made international, and there is a precedent for such an arrangement in the international prohibition of the use of yellow phosphorus in the manufacture of lucifer matches. On the other hand, it is to be remembered that in this instance negotiations were rendered comparatively easy owing to the discovery of a substitute for yellow phosphorus which was equally efficacious; but, as an alternative to lead in pottery glazes, nothing suitable has been found, and any such agreement among the various nations would therefore involve much greater difficulty.

4. *Customers' requirements.*—It is contended that unless perfectly glazed, even articles in which perfection of finish is of no importance, are rejected by the wholesale buyers, and manufacturers aver that they are powerless to prevent the practice; their customers insist on going where they can get the exact articles which they demand.

The most vital matter for the manufacturer is that he shall be able to meet new demands from the world's markets as they arise; during the last 30 years the kind of English earthenware demanded by the American market has radically changed its character three times, and there is a constantly increasing tendency with all buyers to press for articles of the most perfect mechanical finish and smoothness of surface.

Conclusions of the Committee.

The Committee, after reviewing the proposal in all its bearings, considered that the adoption of the schedule was open to two serious objections.

In the first place the difficulty of defining the articles which might be included in it, and the many exceptions which would require to be made would render nugatory any advantage which such a schedule might theoretically afford. To take a typical instance, the ware which is turned out in the familiar form of a "mug" varies greatly in quality. Some of it, such as that for kitchen use, is very common, and might well be scheduled; some, on the other hand, is superior; in certain potteries, for example, where only high-class earthenware is made, it is often the practice, in order to protect their best productions when being fired, to fill the outer rings of the glost oven with mug-like articles, and these could not be made without lead. But whatever their quality, all such goods would come under the same

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* See page 6.

† President of the English China Manufacturers' Association.

‡ Of Messrs. Doulton & Co., Ltd.

§ Of Messrs. Pilkington's Tile and Pottery Co., Ltd.

|| It is stated also that the manufacture of hard-paste porcelain involves risks from dust other than lead which are greater than in the English china industry.

denomination, and, indeed, the more ordinary the type of article might be, the more necessary it would become to permit some latitude in its definition.

In the second place the Committee regarded it as uncertain that the adoption of the proposal would altogether serve to promote the cause of leadless glazes. It has, no doubt, been shown that many varieties of earthenware and china have been successfully made without the use of lead, but owing to the increase of the cost of production involved, it would not be practicable to include the majority of them in a schedule which would be binding on all manufacturers alike. The list, therefore, besides being inconclusive in character, would be a very meagre one; this being so, the public might conceivably conclude that the comparatively few and unimportant articles enumerated were alone suitable for manufacture with leadless glaze, and the interest which they now evince in the question would tend rapidly to decrease.

It must, further, be remembered that leadless glazes are less expensive than those made with lead, and the probability therefore is that, when practicable, the tendency will be to adopt them; notable examples of this are to be found in the stoneware and fireclay branches of the industry, as well as in the common jam-jar trade, in which the use of lead is quite exceptional; at a future date, therefore, it is quite possible that the number of articles capable of being produced with leadless glazes will be sufficiently great either to admit of an effective schedule being drawn up, or to render such a schedule superfluous.

Under these circumstances the Committee, while considering that every possible encouragement should be given to manufacturers to dispense with the use of lead, do not recommend that any attempt should at present be made to prohibit it in the manufacture of certain articles by scheduling them for that purpose.

LOW SOLUBILITY GLAZES.

Substitution of Lead Compounds of Low Solubility for Raw Lead.

The evidence taken by the Committee on the subject of leadless glaze, and the proposal that it should be made compulsory for certain scheduled articles, has now been fully considered, but before setting forth their recommendations with regard to it, it will be convenient to review alternative methods of reducing the danger due to the use of lead in potteries .

Both in England and in foreign countries many efforts have been made to obtain, as a substitute for the lead carbonate or oxide commonly used in glazes, a lead compound less injurious to health, and some time before the introduction of the first special rules which were issued in 1894 partly with the object of preventing lead poisoning in potteries, attention had been directed to the process known as "fritting" the lead as a possible means of lessening its poisonous character.

Process of Making a Fritted Lead Glaze.

The ordinary or "raw lead" glaze is composed, in proportions for which there are various formulæ, of the following materials:—

1. Silicious matter, *i.e.*, flint, stone, clay, etc.
2. Borax, combined with silica, etc.
3. Lead either in the form of carbonate, or less frequently of oxide.

To obtain a lead frit a certain portion of the silicious matter is melted together with the lead, which is generally used in the form of oxide.* The resulting compound is a silicate or mixture of silicates resembling glass, and to make the fritted lead glaze it is ground to a fine powder and mixed, according to the formula used, with the ingredients just mentioned, that is to say, with the rest of the silicious matter and the borax, the latter being first combined with silica, etc. The

* The oxide is no more expensive than the carbonate, and is considerably richer in lead; the consequent economy in using oxide for making lead frits therefore tends to counterbalance the expenses of fuel and labour involved in fritting the lead.

process of fritting is very fully described in a paper drawn up by the Joint Committee of Pottery Manufacturers' Associations in February, 1900, and reprinted as Appendix XXII. of this Report.

Effect of Fritting the Lead.

The effect of melting the lead with silicious matter practically amounts to imprisoning it in such a manner as to render it less liable to the action of the acids which it meets in passing through the human body, and in consequence largely reduces the likelihood of its absorption into the blood; if the frit is properly compounded all but a small fraction of the lead is rendered insoluble, and glazes so made are spoken of as "low solubility glazes." The finished glaze generally contains from 12 per cent. to 22 per cent. or more of lead oxide, but after the process of fritting with sufficient silicious material only from 2 per cent. to 5 per cent. remains soluble. There is considerable evidence* to support the contention that glazes made in this manner will not give rise to lead poisoning, and the silicates are the only lead compounds successfully introduced to take the place of raw lead in pottery glazes.

All Lead Silicates not Equally Harmless.

Solubility in Dilute Hydrochloric Acid as a Test of Harmlessness.

At first it was supposed that any lead silicate would, of necessity, be less easily absorbed into the system than raw lead; but in the course of time it was found that a so-called "mono-silicate" of lead—a compound containing one molecule of silica to one molecule of lead oxide—was freely soluble and gave rise to cases of poisoning. Experiments were consequently made with the object of determining a means of testing lead compounds which would indicate the degree of facility with which the human digestion assimilates them. The earlier work on this subject is reviewed in the Report of the Pottery Committee of 1893†; and an immense amount of further research is described in the Report of Dr. Thorpe and Dr. Oliver‡; both these reports point to the importance of the solubility of a lead compound in dilute hydrochloric acid as a test of its relative harmlessness, express confidence in the ultimate success of low solubility glazes, and advocate continued experimenting in this direction.

Standards of Solubility in Dilute Hydrochloric Acid.

On April 26th, 1899, a document, drawn up by the Joint Committee of Manufacturers' Associations, was signed by leading representatives of all branches of the industry, in which they expressed themselves as willing to frit all the lead used in their glazes, but they did not undertake to adopt any limit of solubility. The main object, therefore, of the process, viewed as a safeguard against lead poisoning—that is to say the reduction of soluble lead to a minimum—remained in abeyance, and to render it operative it was thought advisable to prescribe a method of testing the solubility.

This test was first proposed as a Special Rule on August 2nd, 1900, when it was incorporated in a draft code of Special Rules issued by the Home Office, of which the first two read as follows:—

1. After January 1st, 1901, no material containing lead which has not been fritted shall be used in any of the following places:—

   Dipping houses or dippers' drying-room, or in any of the following processes:—
   Ware cleaning after the application of glaze by dipping or other process,
   Glost placing,
   Colour dusting (whether on-glaze or under-glaze),
   Colour blowing (whether on-glaze or under-glaze),
   Ground laying,
   Painting in majolica or other glaze,
   Glaze blowing,
   Lithographic transfer-making,
   China scouring,

   or in any other place or process in which materials containing lead are used or handled (except for the making of frits) in the dry state, or in

* See page 28.
† Report of Potteries Committee, 1893, C. 7240, pages 10 to 12, and 23 to 24.
‡ Report on Lead Compounds in Pottery, 1899, C. 9207.

suspension in liquid other than oil or similar medium, or in the form of spray.

Provided that nothing in this rule shall prevent the use of any material which conforms to the standard of insolubility specified in Rule 2.

2. After July 1st, 1902, no material containing lead which yields to a dilute solution of hydrochloric acid more than 2 per cent. of its dry weight of a soluble lead compound calculated as lead monoxide, when determined in the manner described below, shall be used in any place or process included in Rule 1:—

"A weighed quantity of dried material is to be continuously shaken for one hour, at the common temperature, with 1,000 times its weight of an aqueous solution of hydrochloric acid containing 0·25 per cent. of HCl. This solution is thereafter to be allowed to stand for one hour, and to be passed through a filter. The lead salt contained in an aliquot portion of the clear filtrate is then to be precipitated as lead sulphide, and weighed as lead sulphate."

This test is generally referred to as Dr. Thorpe's solubility test.

On the 23rd August, 1900, the Joint Committee of Manufacturers' Associations held a meeting at Stoke to discuss the draft of the proposed Special Rules, and certain amendments to it were adopted. On the 26th and 27th October of the same year a conference, at which the manufacturers were represented by Mr. Burton and Mr. Moore,* took place at the Home Office for the purpose of considering certain of the points at issue.

At this conference the draft code was carefully revised, and in Rule 2 the word "glaze" was substituted for the phrase "material containing lead." The rule accordingly read as follows:—

Rule 2: "After July 1st, 1902, no glaze† shall be used which yields to a dilute solution of hydrochloric acid more than 2 per cent. of its dry weight of soluble lead compound calculated as lead monoxide when determined in the manner described. . . . ."

Mr. Burton and Mr. Moore, while unable to agree to so low a limit of solubility as one of 2 per cent., were, at that time, prepared to recommend the manufacturers to accept one of 5 per cent. for ordinary white and lightly tinted glazes. The Home Office, however, would not agree to the compromise, and it was decided to submit the draft rules, as amended, to the arbitration of Lord James of Hereford.

The arbitration proceedings eventually opened on the 12th November, 1901, but by this date the manufacturers had come to the conclusion that, contrary to their expectation, it was impossible to get fritted glazes to act on ordinary china and earthenware bodies in the same way as raw lead glaze, and stated through their counsel that they could not carry out their promise to substitute them, as made on the 26th of April, 1899.

The following witnesses were called to give evidence against the proposed compulsory fritting and low solubility rules:—

1. Mr. W. H. Grindley, of Grindley and Co., Tunstall.
2. Mr. G. E. Meakin, of J. and G. Meakin, Ltd., Hanley.
3. Mr. H. J. Johnson, of Johnson Bros., Ltd., Hanley and Tunstall.
4. Mr. J. L. Whitaker, of Brown-Westhead, Moore and Co., Hanley.
5. Mr. J. Sherwin, of Sherwin and Cotton, Hanley.

Of these firms, Messrs. Grindley and Co., J. and G. Meakin, Ltd., and Johnson Bros., Ltd., are three of the largest manufacturers of high-class earthenware, and trade extensively with the United States of America; Messrs. Brown-Westhead, Moore and Co. manufacture earthenware, sanitary goods, and china of a high-grade quality; Messrs. Sherwin and Cotton are a firm of tile makers of great repute.

Each of these witnesses stated to Lord James that the document of 26th April, 1899, just referred to, had been based on insufficient experience; that, since signing it, they had made many trials and found that they could not frit all

* Both members of the present Committee.

† A reservation was implied in connection with this rule, as only white or lightly tinted glazes had been considered up to that time, and an exemption in favour of highly coloured glazes was therefore doubtless contemplated.

the lead in their glazes without great loss of quality in the bulk of their productions; to such an extent was this the case that they believed that the adoption of compulsory fritting, especially with a limit of solubility, would inevitably ruin the industry.

The Home Office at that time were basing their proposals largely on the theoretical opinions of the eminent chemist, Dr. Thorpe, and the unanimity of these witnesses, speaking with practical experience not only for themselves but also for the Joint Committee of Manufacturers' Associations, no doubt weighed strongly with the Umpire. In order, therefore, to give time to test the matter further, he decided to adjourn the proceedings for eighteen months.

In June, 1903, Lord James of Hereford took further evidence, and his final award, issued on November 28th of that year, established a 5 per cent. standard of solubility. Its adoption, however, was not made compulsory. Manufacturers, by giving due notice of their intention, were left at liberty to use any other glazes, but all giving such notice were subjected to two conditions. In the first place it was required of them that, for all cases of lead poisoning occurring among their employees, whether causing injury or terminating fatally, they should provide compensation, and in the second that they should extend the system of monthly medical examination so as to include adult male workers, as well as women and young persons*, employed in the scheduled lead processes. On the other hand, supplementary special rules were subsequently issued whereby any manufacturer conforming to the 5 per cent. standard was exempted from the use of a fan in the process of ware cleaning (see page 78); any, moreover, making use of glaze not exceeding 2 per cent. solubility could obtain permission to employ workers in the principal lead processes at 14 years of age instead of 15.

Few Manufacturers Conforming to a Standard of Solubility.

The compensation scheme was substantially equivalent to the provisions of the Workmen's Compensation Act subsequently passed in 1906, by virtue of which the right to compensation is now extended to all workers in lead, but the risk entailed could be insured against at a moderate annual premium. On the other hand, the cost of fans for ware cleaning and of the medical examination of adult males, was considerable; none the less, of the 481 factories to which the Award of 1903 applies, no less than 377 preferred to incur the total expense of this rather than to relinquish the privilege of using lead in glaze without restriction, and of the rest, viz., 104 factories, only one qualified for permission to employ workers at the age of 14. Twenty-four adopted glazes conforming to the 5 per cent. solubility standard for the whole of their manufacture, and four, which are coarse ware manufactories, made use only of sulphide of lead, known in its native form as galena, which is rarely found to yield so much as 5 per cent. of soluble lead, and consequently ranks in this report as a low solubility glaze.

There were thus, on January 1st, 1908, 29 firms conforming substantially to the 5 per cent. solubility standard, besides 75 others who, for various reasons, such as, for example, that they used no glaze at all, were not affected by the solubility rule. The classification of these 104 firms will be seen at a glance from the following table:—

Factories using glaze under 5 per cent. solubility - - -	24
Factories using glaze under 2 per cent. solubility - - -	1
Factories using no lead in glaze except in the form of galena -	4
Total factories conforming to a standard of 5 per cent. solubility or under - - - - - - -	29
Factories using no lead in glaze - - - - - -	19
Factories where the ware is only decorated and no glaze used -	44
Factories where there is no lead process - - - - -	5
Factories in which the occupier himself alone handles lead -	4
New factories not classified when the return was made - -	3
	104

* Women and young persons so employed were first subjected to medical examination in 1898.

Absence of Lead Poisoning Cases Traceable to the use of Low Solubility Glazes.

The present Committee have enquired closely into the question whether glaze of low solubility is really innocuous, and have taken all available evidence on the point.

Twelve medical witnesses were questioned, none of whom had heard of a case of lead poisoning arising from its use, and the view that glazes of under 5 per cent. solubility are practically harmless appears to be borne out by the official statistics. Only two cases are reported from all the 29 potteries above-mentioned during the last three years, one of whom was a sagger-washer,* and the other a tile-dipper. The latter, moreover, inasmuch as he had been employed in a lead process for 26 years, may even have contracted the disease before the low solubility glaze was adopted.†

Practicability of Low Solubility Lead Glazes.

It is generally admitted that low solubility lead compounds are not readily adaptable for the production of coloured glazes such as those used for Majolica, Jet, and Rockingham. For these manufactures "low melting point" glazes, as they are called, are required, because it is essential that they should melt and flow at a lower temperature than that at which ordinary earthenware and china are fired. The whole question, therefore, as to the practicability of low solubility glazes is confined to those which are white or lightly tinted, and intended for use on ordinary ware.

Of the witnesses examined, five gave definite evidence in favour of the proposition, namely:—

Dr. Thorpe (now Sir Edward Thorpe), Principal Chemist of the Government Laboratory.
Mr. W. Thomason, Chemist to Doulton & Co., Ltd., Lambeth.
Mr. T. B. Johnston, managing director of Pountney & Co., Ltd., Bristol.
Mr. Joseph Keeling, of Keeling & Co., Burslem.
Mr. E. P. Evans, managing director of the Worcester Royal Porcelain Works.

Evidence of Dr. Thorpe (now Sir Edward Thorpe).

Dr. Thorpe was convinced that fritted lead of low solubility—in which, that is, the total basic oxides are not more than half the acidic oxides—could in practice be satisfactorily substituted for raw lead in by far the greater number of glazes in use at the present time. He was, further, strongly of opinion that it could be adopted successfully in compounding glazes for the very highest quality of ware. He also read letters from Mr. Burton and Mr. Moore, written in 1900, in which the practicability of low solubility glazes for ordinary earthenware and china was admitted, but it must be mentioned that both these gentlemen have departed from the opinions to which they then gave expression.‡

Dr. Thorpe, moreover, testified to the progress made in the use of low solubility and fritted lead glazes by some of the largest factories in Sweden, Denmark, Holland and Belgium. He also read extracts from correspondence, received in 1908, from firms abroad, in which the latter expressed their conviction that lead poisoning had been greatly diminished by the substitution of fritted for raw lead.

Evidence of Mr. Thomason.

Mr. W. Thomason was satisfied that a low solubility glaze could be applied to ordinary earthenware and china goods without loss of brilliance or any other good quality; that the raw lead and a portion of the silica can be replaced by a silicate, containing approximately $2\frac{1}{2}$ molecules of silica to each molecule of lead, without altering either the composition or the character of the final glaze resulting from the

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* Sagger-washing is an operation the object of which is to provide an atmosphere of lead vapour for the ware during the process of baking, and consists in the preparation of the fireclay boxes in which it is placed. (See page 80.)

† It must be pointed out that the total number of lead workers who handle exclusively glazes of low solubility, only amounts to about 260, and that consequently the data are somewhat limited.

‡ See page 35.

glost firing; that such glazes could be fired at the same temperature as a raw lead glaze of corresponding composition; and that the only distinction between raw and fritted lead glazes having the same ultimate composition consisted in a mechanical difference in their behaviour in the dipping tub; in this respect, he explained that the fritted glaze was more inclined to settle, while a glaze compounded of raw lead would remain better in suspension, but he maintained that this mechanical difficulty could be considerably reduced by retaining a certain amount of china clay or other aluminous substance, to be added raw to the powdered frit and the other constituents of the glaze when mixed and ground up together in the mill.

Practical Trials by Mr. Thomason.

Mr. Thomason further undertook to make a series of comparative experiments; these were duly carried out, and on June 30th, 1909, when recalled before the Committee, he categorically stated that, with regard to the main points of his evidence, his opinions remained unchanged and were, in fact, strengthened by the results which he had obtained.

In the experiments in question he adopted the method of glazing a variety of articles in duplicate, dipping one of each pair in a raw lead glaze and the other in one of a low solubility of the same ultimate composition. In support of his conclusions he put the various specimens before the Committee; a certain number, whether glazed with the raw or fritted lead compound, had been bent in the glost fire, but this, he said, was owing to the conditions not being suitable for the production of perfect ware of the type submitted; the glazes had been tried on several different bodies, and he pointed out that when one remained uncrazed, the other did also, and in other cases crazing occurred equally with either glaze; he also displayed a series of small tiles drawn from the glost kiln at various stages of firing, and drew the attention of the Committee to the fact that at the same stage the raw and fritted lead glazes had in each instance respectively reached the same condition. He accordingly maintained that there was no evidence of any difference in behaviour between the two types.

Evidence of Mr. T. B. Johnston.

Mr. T. B. Johnston stated that the goods made by his firm were semi-porcelain dinner services, toilet sets, sanitary ware, flow blue* ware, and all general varieties of earthenware, and estimated, though admittedly it was a mere conjecture, that about 75 per cent. of that made in England was of a similar nature. The firm also has a considerable export trade, the bulk of which consists of semi-porcelain dinner ware of a high class.

All these classes of goods, with the exception of the flow blue ware, which forms only about 5 per cent. of their output, have, since 1903, been made with a glaze of under 2 per cent. solubility; in perfecting this glaze Mr. William Burton, a member of this Committee, was consulted as an expert, and Mr. Johnston considers it to be in no way inferior to one of raw lead. The cost of making it is about the same; the body used is the same, and the number of "seconds" involved is no greater, though this is perhaps partly due to the fact that the firm, at the time at which they adopted the low solubility glaze, moved into a very fine new factory.

In durability Mr. Johnston believes that ware dipped in a low solubility glaze is superior to that made with raw lead. Judging by their own manufactures it is not so liable to crazing, it can be put anywhere in the oven, and he has noticed no difficulty in firing it.

The pottery made by this firm is satisfactory in appearance, and competes successfully with British and foreign ware glazed with raw lead. Their semi-porcelain commands a good price, but is inferior to the high-class earthenware manufactured by the four great North Staffordshire firms for the American market. Mr. Johnston, however, stated very emphatically that he did not consider this was

* Flow blue ware is the name given to earthenware to which a blue printed pattern is applied before glazing, the sharpness of the outlines of the pattern being subsequently softened down in the course of the glost firing by the vapours produced by flow material placed in the saggers.

due to the glaze, but to the superiority of the body and of its finish in the biscuit state; he further suggested that he should be allowed to put his theory to a practical test, and offered, if any of the Staffordshire firms would provide him with a sufficient supply of their biscuit ware, to dip it in his low solubility glaze, fire it in his glost ovens at Bristol, and submit the articles thus produced to a close comparison with that made in the Staffordshire potteries with raw lead glaze. He contended that if he were given such an opportunity, the samples as turned out at his factory would be in no way below the standard.

Of vitreous earthenware,* Mr. Johnston said that, as he had been only making it three or four months, he had not had sufficient experience, and could not therefore tell how it would stand the test of time. He agreed that any restriction in regard to the glaze to be used might be a most serious thing for the trade as a whole, in view of the prospect of such new classes of ware constantly coming into demand; seeing at how small a margin of profit the industry is at the present moment being carried on, he urged that caution should be observed in making any rules that might handicap it.

Evidence of Mr. Keeling.

Mr. Joseph Keeling informed the Committee that his firm make ordinary earthenware of every description, including dinner, tea, toilet and hospital ware, and other "general useful" goods. With the exception of a small quantity of leadless glaze, they have, since 1905, used exclusively a glaze of under 1 per cent. solubility, and have been entirely satisfied with the quality obtained.

Under the present formula the lead is purchased in the form of red oxide which, while costing about the same, goes 14 per cent. further than ordinary white lead. Compared with the raw lead glaze previously used, the low solubility glaze is less adhesive, and less fluid during firing; it is consequently both more difficult to work and more liable to show scratches; none the less, its quality, when finished, is quite as good, and its adoption has involved no loss of ground in competition.

Taking everything into consideration, the cost of pottery turned out with a low solubility glaze is only slightly increased, and in proof of its durability, which he contended was quite on a par with a raw lead standard, Mr. Keeling submitted certain plates to the inspection of the Committee, which had been in constant use for two years. He further maintained, as had Mr. Johnston, that his glaze was in no way inferior to the raw lead glazes of the leading firms who manufacture for the American market. His ware, he admitted, though of good quality, does not command equally high prices, but this he attributed solely to differences in body and workmanship.

Evidence of Mr. Evans.

Mr. Evans stated that prior to 1896 the Worcester Royal Porcelain Co. made exclusive use of raw lead; they then tried fritting it without regard to solubility,† and eventually succeeded in obtaining glazes of low solubility which were satisfactory. These have been adopted for all ware except china‡ since 1900; that of their semi-porcelain dinner services which are largely supplied to hotels, is under 2 per cent. solubility; that in which their Parian or ivory porcelain is dipped contains only 3 to $3\frac{1}{2}$ per cent. of soluble lead.

Their trade in these goods has been quite satisfactory, but how their semi-porcelain competes with ware of the same type, made with raw lead glaze, Mr. Evans was unable to say, as he knew of no other firm making use of a precisely similar "body."

The cost of materials for low solubility glaze he stated to be about the same as for raw lead glaze, but the percentage of "seconds" which it involved to be

* A variety of earthenware which is fired to such a high temperature that the "body" loses practically all its porosity.

† *See* reference to monosilicate frits, page 25.

‡ Made with leadless glaze. (See page 15.)

probably from 10 to 15 per cent. higher. The ware made with the low solubility glaze is, in his opinion, equally durable, and except that it is not quite so smooth, equal in appearance. He admitted, on the other hand, that it does not, in the process of dipping, lay itself so evenly on the ware; before firing, it is more apt to break up and drop off; more attention is in consequence needed, and, for example, three ware cleaners are required for the work previously done by two.

In repeated firings for highly decorated pieces there are always difficulties, which have been considerably increased by the abandonment of raw lead. The cost of production is thus enhanced and Mr. Evans at first estimated the increase to be about 10 per cent.; in his later evidence, however, he modified this statement to the effect that it would be somewhat less than this figure.

Prior to 1898 it was the practice of the firm to apply glazes containing as much as 60 per cent. of raw lead, and, although for the three previous years no case of lead poisoning had occurred in their works, the magnitude of the danger was recognised, and solely for humanitarian reasons it was then decided to adopt such as were of low solubility. With the great reputation they have enjoyed for 150 years it is possible that in certain styles they might have a monopoly. But in any case their cost of production was increased, and up to a certain point they were prepared to incur a pecuniary loss which other firms could not afford.

Evidence Against the Practicability of Low Solubility Glaze.

On the other hand, evidence as to the difficulties involved in the general use of glazes of under 5 per cent. solubility was given by the following witnesses:—

Mr. C. T. Maling, of Maling and Sons, Newcastle-on-Tyne.
Mr. J. C. Bailey, of Doulton and Co., Ltd., Burslem.
Mr. W. Jackson, Chemist to Alfred Meakin, Ltd., Tunstall.
Mr. Joseph Burton, Chemist and Works Manager, Pilkington's Tile and Pottery Co., Ltd., Clifton Junction.
Mr. H. J. Johnson, Director of Johnson Bros., Ltd., Hanley.
Dr. J. W. Mellor, Instructor in Pottery at the County Technical School, Stoke-on-Trent.
Mr. John Ridgway, of Bedford Works, Shelton.
Mr. Lawrence Wedgwood, of Josiah Wedgwood and Sons, Ltd., Etruria, Staffs.
Mr. Henry Watkin, of Macintyre and Co., Ltd., Burslem.
Mr. D. F. W. Bishop, of Bishop and Stonier, Hanley.
Mr. Bernard Moore (Member of the Committee); and
Mr. William Burton, M.A., F.C.S. (Member of the Committee).

Maling and Sons, Newcastle-on-Tyne.

Mr. C. T. Maling stated that his firm make dinner, tea, toilet, and general earthenware goods both for the home and foreign markets, and since March, 1900, have for part of their output adopted a low solubility glaze containing between 1 and 2 per cent. of soluble lead. It was the outcome of experiments made for eight months by Mr. Fred Maling and based on the formula given by Dr. Thorpe and Dr. Oliver in their report of 1899, in the scientific working out of which one of the Professors of the Armstrong College at Newcastle assisted. Every effort has been made by the firm to perfect the glaze, but it has not been a success. From 1903 to 1906 they used no raw lead, and in the first year their sales fell 18 per cent., the second year 31 per cent., and the third year 42 per cent. Thereupon, for their best productions, they again began to use it, and the sales increased 9 per cent. in the first year, 18 per cent. in the second year, and are still doing so in spite of trade being generally bad. Mr. Maling estimates that his firm, in their attempt to dispense with raw lead, lost £20,000.

The materials whether for low solubility glaze, or for one of raw lead, in his opinion, cost the same, but the former is slightly more expensive to make because of the extra cost of fritting and grinding.

The loss in "seconds" in the glost oven firing, he considered, entirely depended on the selection and quality of the ware. He questioned, for example, whether one high-class dinner plate out of twelve made with a low solubility glaze would be good enough to rank with those glazed with raw lead; all sponge bowls, on the other hand, would pass, so that his experience is that for high-class trade all low solubility articles are rejected, and for a common cheap trade all are accepted. In appearance it is possible with such a glaze to produce a small percentage of articles up to the mark, but the bulk of such ware lacks brilliancy, looks rough, has not the soft feel of a raw lead glaze, and is less suitable for subsequent decoration with enamel colours.

Doulton & Co., Ltd., Burslem.

Mr. J. C. Bailey, general manager of the Royal Doulton Potteries, Burslem, whilst not claiming to be a chemist, dissented entirely on practical grounds from the evidence of Mr. Thomason, the chemist at their Lambeth works. He admitted that in 1899 he signed a statement in which the manufacturers in a body undertook to frit all the lead used in their glazes, but from subsequent experience such a practice would, in his opinion, be ruinous to their trade.

Messrs. Doulton and Co.'s output includes every variety of high-class earthenware and china, and during the last ten years they have been making constant experiments with glazes of low solubility. For certain classes of pottery some have been found to be suitable, and throughout one wing of the Burslem works a glaze of solubility between 2 and 3 per cent. is exclusively adopted for sanitary ware and telegraphic insulators; for the highest-class ware, on the other hand, no such glaze has proved satisfactory.

The firm is endeavouring to the best of their ability, to introduce into their ordinary glazes a proportion of bisilicate of lead, but the manufacturing difficulties entailed by the sole use of low solubility lead compounds are very great; the ware does not dip evenly; the glaze does not spread so readily over the ware; it adheres less closely to the body; and is consequently more apt to be rubbed off between the processes of dipping and glost firing, so that it would be necessary to employ more ware cleaners than for pottery dipped in a raw lead compound.

Alfred Meakin, Ltd., Tunstall.

Mr. W. Jackson differed on technical grounds from Mr. Thomason's theory that a low solubility fritted glaze would behave on ordinary earthenware and china in the same way as a raw lead glaze of the same ultimate composition. For a considerable time Messrs. Alfred Meakin, Ltd., tried a low solubility glaze on flow blue patterns, but the attempt was so unsuccessful that, so long as they adhered to it, they had to give up making ware of this description. After the conclusion of Lord James's arbitration in 1903 they desisted from their experiments, and have not since resumed them.

The firm manufactures high-grade earthenware largely for export to America, and the selection is very strict. Their commonest ware will not stand a loss of more than 7½ per cent. in "seconds," and in the witness's opinion they could not keep it down to so low an average with a low solubility glaze.

Pilkington's Tile and Pottery Co., Ltd., Clifton Junction.

Mr. Joseph Burton stated that this Company uses a great variety of glazes, including,

1. Raw lead glazes, containing from 35 to 50 per cent. of lead.
2. Fritted lead glazes, compounded without regard to solubility, and containing up to 50 per cent. of soluble lead.
3. Low solubility glazes containing less than 2 per cent. of soluble lead.
4. Leadless glazes.

The firm manufacture tiles of various qualities and ornamental pottery of many different kinds. In every class a very great number of experiments have been made in glazes during the last ten years, of which as many as 800 were of low solu-

bility. The work has been carried out in a thoroughly scientific manner, and every endeavour made to obtain compounds of the latter type which could be satisfactorily substituted for raw lead, but it has only been found possible to adopt them on a large scale for the cheapest quality of tiles made.

Mr. Burton further pointed out that there was no law requiring such experiments to be made. They were undertaken voluntarily, solely on humanitarian grounds, and had involved a cost of many hundreds of pounds. After all the labour and expense incurred, he is at the present moment less sanguine of success than he was ten years ago, owing to the development of difficulties which he had not anticipated.

Mr. Burton also produced samples of ware to show that glazes of the same ultimate composition, but built up in various ways, behave differently under the same conditions of temperature and time in the firing process. Of these some were trial tiles which had been dipped in glazes containing 35 per cent. of lead, some raw and some fritted, and had been drawn from the oven when only partially fired. In his opinion any alteration in the way in which a glaze is built up may involve serious difficulties apart from chemical composition. With such as are of low solubility more damaged goods result than from the use of raw lead, and, in particular, a dry scum is apt to come on the edges of the tiles dipped in them.

Johnson Bros. (Hanley), Ltd., Hanley and Tunstall.

This is the largest firm of pottery manufacturers in the United Kingdom; their production consists of all kinds of high-class earthenware, a large part of which is exported to the United States of America.

Mr. H. J. Johnson, one of the directors, stated that in former years they made very extensive experiments and spent a great deal of money in trying to obtain a good low solubility glaze but without any satisfactory results. Those tried invariably failed to give as good a finish as that obtainable with raw lead, and were not therefore suitable for any of their manufactures.

As previously stated in connection with leadless glaze (page 18), the firm employed an expert for 38 months to make experiments for them, but at the end of that time considered that, as there was no prospect of success, they were justified in discontinuing their efforts. They have made no further attempts since Lord James's award in 1903.

Evidence of Dr. Mellor.

Dr. J. W. Mellor gave much evidence of a technical character, in which he differed entirely from Mr. Thomason's conclusions.

Dr. Mellor is not in any way engaged in the manufacture of pottery, but, as a scientist, has for the last four years been brought into contact with pottery problems in his capacity of director of the technical school for pottery instruction at Stoke-on-Trent.

His evidence was based entirely on results obtained with experimental glazes, and he did not speak of any in practical use on a large scale. In his opinion, however, the introduction of low solubility glaze, as a general substitute for that made with raw lead, would involve difficulties which could not be overcome, and the abandonment of the latter would be disastrous.

Ridgway's, Hanley.

This firm do a large export as well as home trade in earthenware of a high grade.

Mr. John Ridgway stated that, in his opinion, the adoption of a low solubility glaze would be productive of a great deterioration in the quality of flow blue ware, and for other classes of their manufactures, including even undecorated white ware, he does not consider such glazes to be suitable.

This witness has not personally made many attempts to use low solubility glaze, because he has been content to rely in the main on the experience of men more skilled than himself as chemists and potters. He did make some experiments prior to the arbitration of 1901-3, but since that time he has only done so on a very small scale: an attempt to alter the glaze for flow blue ware resulted so disastrously that he felt he dared not go further for fear of losing the trade. He regarded it as extremely dangerous, especially in view of foreign competition, to tamper in any way with the materials used by British potters.

Josiah Wedgwood & Sons, Ltd., Etruria, Staffs.

Mr. Lawrence Wedgwood stated that prior to 1903 his firm employed Mr. Wilton Rix for a period of rather over two years to conduct experiments for them in glaze of low solubility. They suffered great loss in regard to the tint of the blue colours, and also by reason of the edges of the enamel colours peeling off; this latter defect did not make itself apparent until the ware was in the customer's hands, and, when the customers complained, the firm had to stand the loss as well as the discredit.

Messrs. Wedgwood make a great many varieties of ware, both earthenware and china, of the highest quality; a most important part of their present business consists in the reproduction of patterns made by the firm as much as a century ago, for which they find fritted glazes, then unknown, to be unsuitable.

Macintyre & Co., Ltd., Burslem.

Mr. Watkin is himself a chemist, and was one of the first to make a low solubility glaze; in giving his evidence he spoke also on behalf of four other firms, all of which, as well as his own, are engaged, as already mentioned, in the manufacture of china furniture and electrical fittings. They use low solubility glazes wherever they find it possible to do so, but Mr. Watkin does not consider that they could dispense with raw lead entirely; the low solubility glazes, as well as the leadless, have such a small margin of success, and the cost of production would by their sole adoption be so much increased, that it would be impossible for ware made with them to compete in open markets.

Experiments were, however, still in progress with a view to extending their use, but the result of one of the latest trials tends to prove the truth of his contention; about 10 per cent. of the articles dipped in low solubility glaze were so lacking in finish that they would not fetch the normal prices in competition with foreign-made goods. The English manufacturer is only able to obtain his prices by reason of the superior quality of the ware he supplies, and those on the Continent, in order to supply the demand for goods of the English type, are beginning to make pottery similar in body to English earthenware, and similarly glazed.

Makers of china furniture and electrical fittings are, moreover, daily asked to supply new patterns, and for this reason also they ask to be allowed the freest possible use of every kind of raw material.

Bishop & Stonier, Hanley.

Mr. D. F. W. Bishop, manager of this firm, stated that they made experiments with low solubility glazes in 1900 and 1901, but the results were so disastrous that they have made no more since the latter year. The ware so glazed was of inferior quality, and involved the firm in financial losses. Nothing has since transpired to lead them to believe that they could improve on the trials made at that time.

Evidence of Mr. Bernard Moore (Member of the Committee).

Mr. Moore stated that he has been a glaze manufacturer for a great number of years and has made many low solubility glazes containing from 1 per cent. up to 4 or 5 per cent. of soluble lead. One of these was used by his own firm, Messrs.

Moore Bros., China Manufacturers, Longton, from the time of the arbitration until they ceased manufacturing, and he was convinced that in consequence the quality of the china which they made was lowered.

Mr. Moore also dissented strongly from the opinions expressed by Mr. Thomason. He maintained that a fritted lead glaze of low solubility behaves, in the process of firing, quite differently from a raw lead glaze of the same ultimate composition, and supported his belief with much detail of a technical character; fritted lead, moreover, in his opinion, involves more trouble in dipping; this is not an insuperable difficulty, but greater care is needed in handling the ware, which necessitates the employment of additional lead workers.

With reference to the occasion in the autumn of 1900, when he and Mr. Burton, as representatives of the Joint Committee of Manufacturers' Associations, expressed their readiness, at a conference held at the Home Office, to recommend the manufacturers to agree to a 5 per cent. limit of solubility for white and lightly tinted glazes, Mr. Moore said:—

> At that time I looked upon the question more from the china manufacturers' point of view than anything else, as far as my own knowledge was concerned. In view of what we had been told by Dr. Thorpe, and his evidence with regard to the matter and the use of this low solubility glaze, I consider that I was led away. I was a little bit enthusiastic, and I was particularly anxious to do this. I think that I was premature in what I undertook to do. I was carried away by the apparent success of comparatively small trials, and I thought that as far as china was concerned I should get over all the difficulties. As far as earthenware is concerned, I was not responsible. The manufacturers asked Mr. Burton and me whether they could frit their glazes, keeping the composition the same—whether they could be turned into insoluble glazes without altering the ultimate composition. Of course that could be done. I have not receded from that position. But the more experience I have had, the greater I consider the limitations of fritted lead glaze, and the opinion that I now hold is the opinion that I have held since the arbitration. It is probably strengthened. At the arbitration I said that the introduction of a standard of low solubility would, in my opinion, have the effect of ultimately closing the majority of the works of the Potteries, and I am of the same opinion now.

Evidence of Mr. William Burton, M.A., F.C.S. (Member of the Committee).

Mr. Burton, equally with Mr. Moore, dealt with the position of affairs in the autumn of 1900. In a letter dated 24th December of that year he had advised the Home Office to the effect that "after a great deal of trouble" the manufacturers had agreed to accept the standard of 5 per cent. solubility for white and lightly tinted glazes, and explained the expression as meaning "after making a great many experiments." This letter was written some five months after the proposal was first made, and in the interval Mr. Burton and Mr. Moore were having low solubility glazes of their own compounding tried both at their own works, viz., Messrs. Pilkington and Messrs. Moore Bros., and elsewhere. At the same time Messrs. Johnson Bros., Messrs. Grindley and Messrs. Alfred Meakin, Ltd., were trying similar glazes made for them by Mr. Jackson, as before mentioned.

The early results of these attempts were very promising, but it was inevitable that some time should elapse before the adoption of such glazes could become general. In a large factory, in order to avoid the inconvenience of fluctuations and little changes of small and occasional grindings, it is usual to keep two or three months' supply of glaze in reserve, and consequently it might have been six or seven months before any attempt was made to use a pure low solubility glaze without any admixture of the stocks in hand containing raw lead.

As the low solubility glaze came more and more into use, its defects became apparent, and when it was evident that it was proving to be a failure instead of the success which they anticipated, Mr. Burton considered that the only honest course was to withdraw the undertaking which he and Mr. Moore had jointly given on behalf of the manufacturers.

In answer to a question as to what would have happened to the industry if, in 1900, the Home Office had accepted the offer to adopt a 5 per cent. solubility standard, Mr. Burton replied that they would have had to explain the whole circumstances to the Home Office, and ask for the withdrawal of the rule on the ground that it was impossible to manufacture under it.

Mr. Burton added that he was in accordance with his brother, Mr. Joseph Burton, in feeling much less hopeful of the ultimate success of low solubility glazes now than he felt ten years ago.

On the technical points as to the respective behaviour of low solubility and raw lead glazes in the firing process, Mr. Burton expressed his unqualified dissent from Mr. Thomason's opinion and his entire accord with Mr. Moore's belief that disastrous results would follow any attempt to make general use of the former.

No concerted action has ever been taken by manufacturers for the purpose of discovering new glazes, except in so far as Mr. Burton and Mr. Moore have rendered assistance to other manufacturers when applied to for help in improving specimens which were defective. The works' chemists at various important potteries have been working continuously at the problem, but there has been no question of the Joint Committee of the Manufacturers' Associations appointing an expert potters' chemist for this purpose, and Mr. Burton doubts if such a man is available.

With reference to a suggestion that further experiments should be carried out by Mr. Thomason with the co-operation of the heads of the Royal Doulton Potteries at Burslem, Mr. Burton said that such defects as crazing often do not make their appearance until the ware has been sent half round the world, and it may be returned as defective any time within two years. He would not accept any test as conclusive on a large scale, unless it had been continuous for at least two or three years.

With regard to the offer of Mr. Johnston,* to dip a quantity of best earthenware plates made by one of the leading North Staffordshire firms in his low solubility glaze, Mr. Burton said that there were grave objections to sending biscuit ware to a rival manufacturer's works; there is a good deal to be learnt in respect of the composition of the body and its behaviour in firing, which a competitor might discover by having access to it in the biscuit state.

Mr. Burton's attention was called to the statement made to Dr. Thorpe by certain large firms of Continental potters, to the effect that they had dispensed with raw lead, and his opinion was asked as to the quality of the ware they produced; in reply he said:—

> English earthenware remains to-day . . . . . . the finest earthenware in the world, and radically different both in composition and in quality, from anything that is made on the Continent.

He further pointed out that Dr. Thorpe's conclusions were based on the practice of a few large works only; his own acquaintance, he mentioned, embraced all kinds; he said:

> I have not only visited picked works on the Continent, but I have spent holidays tramping about among little potters, working with them, helping to set in kilns, and doing all kinds of things. I know the conditions of the small manufactories and of the big manufactories, and there is no comparison between the two.

His experience, he stated, had led him to the conclusion that on the Continent raw lead glazes were freely used, and glazes of low solubility but little.

The difference between the bodies used respectively by foreign and English manufacturers, Mr. Burton explained as follows:—

> A potter must work with the materials that he can most conveniently obtain. If a potter starts to work in a new country, or if a manufacture like that of English earthenware is introduced into a new country, first of all the people in that country try to import the exact materials that are used in this country; but after a time, by practice and experience, if they find that the carriage of the materials is exceedingly great and a very costly item, they begin to hunt round in their own country for the nearest materials they can get to substitute for them. In that way many of the foreign earthenware bodies, although originally based on English practice, are quite different in composition and character.

Mr. Burton also stated that in the only country, namely, Holland, in which stringent rules against the use of raw lead have been introduced, it had been found necessary, according to proof in his possession, to suspend their operation.†

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* Of Messrs. Pountney & Co., Ltd., Bristol.

† See page 38 and Appendices.

Evidence of Buyers of Pottery.

H.M. Office of Works.—Mr. Hillier, Controller of Supplies, stated that their present contracts are confined to glazes not exceeding 5 per cent. solubility, and that the ware supplied in accordance with this limitation, namely, plain white pottery with a medallion badge, has been entirely satisfactory. He further quoted the prices of several articles, and said that on the whole the restriction to low solubility glaze had made no difference to them.

Admiralty.—Mr. F. W. Black, C.B., Director of Navy Contracts, stated that the Admiralty have recently obtained samples of the ware bought by H.M. Office of Works, to see whether it will suit their requirements, but so far, since 1905, have made no stipulation that the lead used in the glaze of that purchased for the Navy should in any way be limited. They have, however, made inquiries, and have reason to believe that a large proportion of the pottery supplied to them in recent years, and accepted as entirely satisfactory, has been made with glazes containing very little lead in a soluble state.

War Office.—Lieut.-Col. Moore-Lane, Chief Inspector of General Stores at Woolwich, said that, in inviting tenders, they have made no restrictions in regard to the glaze since 1904; it appeared, however, from his evidence, that, to a considerable extent, contracts were made with firms known to use only such as were under 5 per cent. solubility. This seems to show that at least certain varieties of such goods are able to hold their own in competition with similar ware made with raw lead glaze.

Post Office, Telegraph Department.—Mr. Hartnell, of the Engineer's Department of the General Post Office, said that they make no stipulation in regard to lead glazed insulators, but he believes that they are all dipped in glazes containing less than 5 per cent. of soluble lead.

Messrs. Thomas Goode and Sons, Earthenware and China Retailers, South Audley Street, London, W.—Mr. Minton Goode has made no special observation of ware made with low solubility glazes, but he deals to some extent with potteries where no raw lead is used. In the case of at least one firm, which had given it up in the course of the last few years, he had noted no deterioration in quality.

Other Method of Working under the 5 per cent. Solubility Limit.

It has already been stated (see page 25) that the process of fritting with a large proportion of silicious material renders the greater part of the actual lead in the compound insoluble, and the amount of actual lead oxide in almost all glazes conforming to the 5 per cent. solubility standard ranges, when calculated as monoxide of lead, from 12 per cent. to 22 per cent.

If, however, a manufacturer uses a glaze which contains less than 5 per cent. of lead oxide altogether, he may dispense with the fritting process, and still conform to the standard; the total lead oxide in such a glaze being under 5 per cent., it follows of necessity that the amount which is soluble will also be within that limit, even if the whole of the lead goes into the dipping tub in a raw state.

Some members of the Committee called on a firm who stated that they had adopted this method of working under the 5 per cent. solubility standard; they were not, however, prepared to send a representative to give evidence before the Committee in this matter.

Regulations in force in various Foreign Countries, with special reference to Limitation of use of Lead.

The Committee have had under consideration the practice obtaining in foreign countries with regard to the prohibition or restriction of the use of lead. They concluded, however, that the time and labour, as well as the expense involved in a visit paid by them personally to investigate the conditions abroad, would be

disproportionate to the value of the evidence procurable by such means; they therefore took steps to obtain, through the medium of the Foreign Office and His Majesty's representatives in certain foreign capitals, written information regarding the most recent developments of industrial legislation applicable to potteries.

Complete translations of the more important documents received will be found in the Appendices to this Report, and the following is a brief summary of those from France, Germany, the United States of America, Belgium, and the Netherlands.

France.

The Decree of the President of the French Republic, dated 23rd April, 1908, provides for ventilation, the wearing of overalls, and the use of lavatories. It also requires that the floors of specified workplaces shall be constructed in a particular manner; that, in certain circumstances, respiratory masks shall be worn; and that pottery shall be dipped with tongs or other tools; or, alternatively, that gloves shall be worn. See Appendix XLII.

Germany.

No special rules are in force for dealing with the health of workpeople engaged in the manufacture of pottery. The Imperial Government are, however, at present considering regulations for the protection of workers against lead poisoning.

There is a German Statute known as the "Law of the 25th June, 1887," for the protection of those making use of pottery, which provides that the finished article must not give up any lead in the course of a half-hour's boiling with 4 per cent. acetic acid. See Appendix XLIII.

United States of America.

None of the States in the Union have special laws dealing with the protection of pottery workers.

Belgium.

The legislation at present in force consists of:—

(1) General regulations regarding ventilation, lighting, heating, lavatories, cleaning of floors.

(2) Special regulations which may be made in any particular case and specified as conditions for granting a licence to any factory.

In Appendix XLIV. will be found a translation of a note received from the Belgian Ministry of Labour, through H.M. Representative at Brussels and the Foreign Office, and, also, one of extracts from laws and decrees in force.

Netherlands.

The decree regulating work in potteries at the time of the commencement of this enquiry was dated 13th July, 1906, and enacted that:—Young persons under 16 and women must not be employed unless materials of less than $2\frac{1}{2}$ per cent. solubility, according to Dr. Thorpe's test, are used; and in addition provision was made for medical examination every two months, adequate cubic space, lavatories, cleansing of floors, and supply of overalls before each period of work. See Appendix XLV.

A report published in 1908, by the Factory Inspector at Deventer, called attention to certain difficulties in the enforcement of these rules, and a new decree was promulgated on the 12th August, 1909, which enumerates stringent conditions in regard to the employment of women and young persons in certain processes, and excludes them entirely from certain of the most dangerous. A summary of the new decree is appended. See Appendix XLVI.

CONCLUSIONS IN REGARD TO RESTRICTIONS IN THE USE OF LEAD.

This concludes the evidence for and against the practicability of adopting low solubility glazes for white or lightly tinted ware, and it will have been noted that the arguments are very similar to those put forward in respect of leadless glazes. In making their recommendations on the subject of the restriction of the use of raw lead, the Committee consider it will be best to sum up these two sections of it consecutively, and then state their decision with regard to it as a whole.

1. *Leadless Glazes.*

The general conclusion to be drawn from the evidence in respect of the use of leadless glazes is:—

That in all classes of pottery-ware, whether of the best, medium, or common qualities, a great many articles can be manufactured, in a very high state of perfection, with leadless glaze.

At the same time, however, it appears:—

(*a*) That in certain classes of common ware the cost of production is not appreciably increased, and in the commonest, such as jam-pots, and the ware known in the trade as "Persian painted," may even be reduced.

(*b*) That in certain other classes, whether of the best or medium quality, leadless glaze, owing to the excessive number of "seconds," can only be used at such an increased cost or sacrifice of quality as possibly to entail the loss of important markets.

(*c*) That owing to difficulties relative to accuracy in reproducing old patterns, colours or methods of decoration, certain kinds of ware cannot at present be made at all without the use of lead.

In view of these conclusions, the suggestion was made that a schedule of articles should be issued in the manufacture of which the use of lead should be prohibited, but the Committee, after giving the matter most careful consideration, decided that such a course was impracticable. (See page 23.)

2. *Glazes limited to 5 per cent. of Soluble Lead.*

The evidence in respect of low solubility glazes is very conflicting, and it is, in consequence, not easy to draw equally definite conclusions from it. Several witnesses strongly urged that such glazes might justifiably be regarded as efficient substitutes for raw lead glazes, but others, with equal insistence, deprecated any interference with any glaze at present in use.

It is universally admitted that glaze made with raw lead possesses four attributes of the greatest importance, viz.:—

(*a*) The ingredients of the glaze are readily maintained in a state of suspension, and therefore the ware becomes easily coated with it.

(*b*) The ware is easy to handle between the processes of dipping and glost firing.

(*c*) The glaze flows readily over slight obstacles and so conceals minor defects.

(*d*) The use of the glaze is productive of only a small percentage of loss in "seconds."

In regard to the first of these attributes, the superiority of these glazes is admitted by the advocates of the low solubility standard, but its strongest opponents allow that the mechanical difficulties involved are not insuperable. The second was conceded by most of the witnesses examined. In the third and fourth, if the testimony of such experts as Dr. Thorpe and Mr. Thomason, and such practical authorities as Mr. Johnston* and Mr. Keeling is accepted, viz., that lead can be fritted to a low solubility without altering the subsequent behaviour of the glaze in firing—the inferiority of such glazes in this respect amounts to practically nothing, but the accuracy of this testimony was strenuously denied both by other experts and by manufacturers of the highest authority and widest experience.

Again, some firms have altogether discarded the use of raw lead, while others have tried fritted lead with such unfortunate results as, in their belief, to have jeopardised their trade. The Worcester Works use low solubility glazes even

* Of Messrs. Pountney & Co., Ltd.

for their finest semi-porcelain and Parian ware, but the cost of production is admittedly so enhanced that other firms, with the narrow margin of profit at their disposal, say they cannot afford it, and those exporting to America aver that, without making use of raw lead, they cannot maintain the quality necessary to hold that market.

Messrs. Pilkington & Co., Messrs. Doulton & Co., and a few others have steadily endeavoured to obtain satisfactory glazes of low solubility, but there has been no concerted action, and most employers seem to have regarded the Compensation Scheme propounded by Lord James of Hereford in 1903, as a permanent settlement of the problem, and ceased to make any further experiments at the very moment when they should have redoubled their efforts.

With such contradictory evidence before them the Committee have found themselves in a very difficult position. The members representing the manufacturers are entirely opposed to any restriction in the use of raw lead; the representatives of the workers, seeing the comparatively harmless character of low solubility glazes, would be glad to see them generally introduced, but have to consider the grave risk of loss of employment which any dislocation of the industry due to their introduction might entail.*

Conclusions of the Committee.

Taking, however, the question of glazes as a whole, two facts are beyond dispute. In the first place, the danger to the workers of handling raw lead, whether from direct poisoning or from general deterioration of health, is very real; in the second it is evident that, however unsuitable leadless and low solubility glazes may be for certain classes of ware,† there is a considerable quantity made for which they are quite satisfactory.

For all such pottery, if it had lent itself to definition in its various branches, it might have been practicable to insist on the use of such glazes, but in view of the wide field it covers, and the innumerable exceptions which it would be necessary to make, any attempt at classification could not have failed to cause too great a disturbance in the trade. The Committee are, however, fully alive to the necessity of minimising the danger and consider that every inducement and encouragement should be given to the manufacturers both to persevere with their experiments in search of satisfactory leadless and low solubility glazes, and to introduce them whenever possible. In this respect it should be remembered that hitherto the policy of the Home Office has been to grant certificates suspending certain of the Special Rules in the case of those firms who have given an undertaking either to use no lead or to conform to certain limits of solubility, and the Committee recommend that in all those factories where leadless glazes are adopted, and in a proportionate degree in those where glazes of low solubility are used, the rules relating to lead departments should, so far as may be consistent with the health of the workers, continue to be relaxed.‡

In addition to such an appeal, efforts should also be made to arouse the interest of purchasers in the question. By the evidence of such witnesses as those for the Government Departments, and Messrs. Goode & Sons, it was established that pottery made with leadless and low solubility glazes can be obtained of excellent quality, and the Committee consider that the desirability of insisting on being

* The manner in which the attitude of both manufacturers and operatives may be governed by the supply of labour is indicated in an interesting way in the account which Mr. Johnston, of Messrs. Pountney & Co., Limited, of Bristol, gave as the reason which led his firm to adopt exclusively leadless and low solubility glazes. In Bristol there are many different avenues of employment open to workers, both male and female, and Messrs. Pountney & Co., found that so long as occasional cases of lead poisoning continued to occur at their works, they were unable to obtain the labour they required; hence they took the step of abandoning raw lead glazes, thereby terminating the history of plumbism so far as they themselves were concerned, and no longer experience any difficulty. But in the North Staffordshire Potteries, except possibly mining, in the case of men, there is little other outlet for labour, and the operatives are therefore naturally disposed to adopt an extremely cautious attitude towards any proposals which might adversely affect the staple industry.

† As mentioned on page 28, it is generally admitted that it is difficult to dispense with raw lead in ordinary Majolica, Jet and Rockingham glazes; no evidence was given to show that the same effects could be obtained with either leadless or low solubility glazes in the case of coloured wares of these varieties.

‡ The particular rules to be relaxed, and the extent of the permissible modifications will be indicated in connection with each process affected. *See* pages 64 to 123.

supplied with such ware should be brought home to the public at large;* in this respect the Government Departments might well set an example to private purchasers.

The Committee have, however, decided not to recommend the prohibition of the use of raw lead in glazes at the present moment. With regard to the prevention of the danger, they are satisfied that if the precautions which they have agreed to recommend in relation to lead processes (see pages 64-123) are adopted and effectively carried out, they will, in conjunction with those now in force, reduce the risk to a level common to all industrial occupations.

Hitherto, the observance of the special rules has been far from satisfactory. In the past many of the manufacturers do not appear to have regarded it as incumbent on them personally to insist upon it; they have left the initiative to the factory inspectors, and in future they should be made to realise that they are themselves responsible. The Committee have, therefore, endeavoured to attain this object rather than to attempt any such interference with the trade as the prohibition of lead might involve; they have accordingly proposed, later in this report, that a special method of supervision be adopted for ensuring constant vigilance on the part of the manufacturers in maintaining throughout their works a thorough and continuous observance of the prescribed precautions.

OTHER DISEASES attributable to the Conditions of Labour in Potteries, and productive of excessive Mortality and Suffering.

When reasonable provision has been made to meet the ill effects of the use of lead in glazes, whether in the form of actual poisoning or general bad health, there still remain other occupational diseases in potteries of a very serious and widespread character, against which no sufficient safeguards have as yet been introduced. Owing to the conditions of labour, the workers are specially prone to affections of the lungs, and the medical evidence given before the Committee proved that the mortality due to these affections is abnormally high. Dr. Russell reported that, after examining 458 workers, no less than 52 per cent. of those over fifty years of age, of whom there were 38 in all, showed signs of lung disease. Several other witnesses testified to the same effect, notably Dr. Petgrave-Johnson, maintaining that they would have expected the percentage to be still higher; and, according to Dr. Shufflebotham, bronchitis caused 4·4 times as many deaths among pottery workers as among the general population.

Striking as these statistics are, they appeared insufficient to represent the whole case. There were, however, no others available, except those embodied in Dr. Tatham's supplement to the Report of the Registrar-General, which only gave data for a comparison between workers in potteries and other artisans throughout the length and breadth of the country. Any conclusions, therefore, that might be drawn from these were open to the contention that some of the excessive mortality among the former might be due to the conditions of soil and climate in the Potteries rather than to methods in vogue in the industry, and the Committee accordingly asked Dr. Reid, who is one of their members, to draw up a comparison between the death rate due to phthisis and other diseases of the respiratory organs among the pottery workers in the six North Staffordshire towns and that among other artisans employed in the same districts.

Comparison of Death Rate and Extent of Suffering due to Diseases of the Lungs and that due to Lead Poisoning.

For this purpose the necessary arrangements were made by the courtesy of the Registrar-General, and Dr. Reid drew up the Memorandum which is given in full in Appendix XXXIII. of this Report. His conclusions were, briefly, to the

* A simple test, to show approximately how much lead has been used in the glaze of a piece of pottery, was described by Sir Henry Cunynghame, K.C.B., in his evidence. See also Appendices L. and LI.

effect that, as compared with an equal number of other artisans in these districts, there is, taking the years 1900-1902, an annual excess among pottery workers of 148 deaths due to the diseases in question, attributable, it would appear, to the unhealthy conditions under which they labour. This figure is made up as follows:—

	Male.		Female.		Total.
Annual excess number of deaths from phthisis among potters - - - - - - - - - -	33	...	26	...	59
Annual excess number of deaths from other respiratory diseases among potters - - - - - - -	67	...	22	...	89
Totals - - - - - -	100		48		148

The excess mortality, on the other hand, attributable to lead poisoning, only amounts to 4 deaths per annum,* which represent a far lower death rate. In North Staffordshire there are 47,466 workers employed in the pottery trade, of whom 5,299 are lead workers, and about 21,000 are exposed to excessive risk of contracting lung diseases. The comparative excess death rates are, accordingly, as follows:—

Class of Workers.	No. of Workers in North Staffordshire Potteries.	Calculated annual excess deaths attributable to employment.	
		Actual Deaths.	Rate per 1,000.
Those exposed to excessive risk of lung diseases	21,000	148	7·0
Lead workers - - - - - - -	5,299	4	0·8

Taking, therefore, the actual number of excess deaths, between 30 and 40 die annually from lung diseases to 1 from lead poisoning; and, taking the rate per 1,000 exposed to risk, the former are more than eight times as fatal as the latter.

But if the mortality caused by these diseases is so much greater, there is reason to believe that the suffering which they occasion among the living is at least in the same proportion. Of this there is, unfortunately, no actual proof. Under the present law there is no obligation to notify cases of such illnesses as bronchitis or phthisis, except the latter disease in the case of paupers. A tabulation of all cases of lung disease would, for the purposes of this inquiry, have afforded most valuable information; the Committee would have been in a position to draw a comparison between the suffering attributable to such diseases and that caused by the assimilation of lead, but, as it is, in default of such statistics only a rough estimate can be formed from the record of actual deaths. In either instance death must be preceded by a period of much pain and ill-health. On this point, again, there is a lack of actual data, but Dr. Reid believes that the mean duration of phthisis, previous to its fatal termination, is at least three years, and that of other affections of the lungs probably much longer.

The evidence of several medical witnesses, as well as that of pottery workers, tends in the same direction, and it therefore appears reasonable to infer that the suffering arising from these diseases is, at least, proportionate to the increase in the death rate, and possibly far greater. With lead poisoning, for example, a patient may suffer from colic which lasts for only three weeks; with affections of the lungs, on the other hand, while serious symptoms may not be developed for years, the disease grows steadily, accompanied by the extreme discomfort and misery incidental to such diseases.

Causes of Excessive Lung Diseases.

From the medical evidence taken by the Committee, there is no doubt that the virulence of lung diseases in the pottery trade, and the excessive mortality due to them, are in the main caused by the inhalation of dust, especially of flint dust, and to a lesser extent by moist and impure air due to defective ventilation. In this view the majority of the doctors agreed, but Dr. Partington, Dr. Dawes, and

* See Table on page 10.

Dr. Shufflebotham, while not belittling the evil effects of constantly breathing the dust, were inclined also to attribute the deadly nature of the diseases to the prevalence of high temperatures in the workrooms.

But be this as it may, the excessive death rate from lung diseases and the general discomfort which attends them, must not be laid wholly at the door of the present generation of employers. In the above returns (1900-2) the average age at which the deaths occurred was slightly over 47 years, and the potters in question, who probably started work at 10 years of age, may therefore be taken to have commenced in 1865. On the other hand, the medical evidence shows that in a susceptible subject 20 years' employment in a dusty process would easily suffice to affect the lungs; it follows, therefore, arguing from the mean, that such a man might well have been suffering from respiratory trouble by 1885, considerably—that is—before the introduction of the first code of Special Rules dealing with dusty processes, which was only issued in 1894.

Similarly it may be contended that potters whose deaths occur in 1910-12 would, on the average, be men who had commenced work about 1875, and would therefore have completed 20 years before any material improvement of conditions could have resulted from the rules of 1894. It will, accordingly, be necessary to wait until the statistics for 1920-2 are published before it will be possible accurately to estimate the value of the Special Rules for dealing with dust in this industry.

But although many of the employers of to-day cannot be held responsible for the present degree of lung affection, it is none the less incumbent on them to avoid as far as possible the risk of leaving their successors a legacy of trouble similar to that left to them by their predecessors. The rules of 1894 introduced exhaust fans for the towing of earthenware; those of 1898 made universal a similar provision for china scouring, but there still remain a great number of processes requiring attention in which dust, and frequently silicious dust, although not so palpable, is nevertheless inhaled in appreciable quantities; while, therefore, the legislation affecting towing, scouring and the like, has greatly ameliorated the working conditions of small sections of the operatives, a vast majority of them, employed as hollow-ware pressers, fettlers, jiggerers, tile-makers, etc., are still exposed to the widespread danger; in their case it may assume a form somewhat less acute, but many of them must stand in urgent need of adequate protection.

Insufficient attention paid in the past to the Inhalation of Dust.

The danger arising from general dust in potteries is no new discovery. Dr. Arlidge, in his work on the "Diseases of Occupations," so long ago as 1892, very fully pointed out the evils resulting from it, and the Home Office Committee, which inquired into the health conditions of the pottery trade in 1893, in the course of their Report,* also state:—

> "The ill-effects of the trade are referable to two chief causes, viz., dust and the poison of lead. The former is of wider action, as it pervades all the operations or processes wherein potters' clay and flint in powder are in use."

These statements were further confirmed by the writings of many other experts, but none the less little public attention has been paid to the urgent need of dealing with the dust problem as compared with that of preventing lead poisoning.

Recommendations.

In addition, therefore, to those improvements in regulations and administration which they propose in respect of the latter, the Committee desire strongly to advocate such measures for the removal of dust, for good general ventilation, and for securing a reasonable temperature in the workrooms as will be best calculated to minimise the risk of injury to the lungs. They have accordingly decided to make definite recommendations to this effect, and in framing them it will be most convenient to review the various processes of manufacture in the order in which they occur, examining the degree of danger incidental to each, and defining the remedy or precaution suitable to it.

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* Report of Potteries Committee, 1893, C 7240, page 4.

PROCESSES OF MANUFACTURE.

Materials for "Body."

It will be remembered that the "body" is the foundation of all articles of pottery, and that it consists (see page 5) either of a simple native clay or of a mixture of several ingredients, such as Cornish stone, and china clay, combined in the case of china with calcined bone, and in that of earthenware with ball clay and calcined flint.

These materials are generally received at the pottery in the form of rough blocks or cakes, which, when handled in a dry condition, throw off a certain amount of dust. They are frequently stored in an open yard for long periods, and at this stage the quantity of dust to be considered depends somewhat on atmospheric conditions: after a spell of rain there is practically none, but after a week of summer weather there may be a good deal.

Several members of the Committee, when visiting potteries, satisfied themselves by personal observation that dust is neither continuously nor even frequently generated; occasionally, however, there is some slight risk; the raw materials when required are carried in open boxes or trucks, and enquiry was made as to whether the men handling them should wear respirators.

This proposal Dr. Legge opposed on the ground that the work was too laborious, and the Committee see no need for any special rule to regulate the operation; they suggest, however, that if the materials when carried as above described are dry enough to throw off dust, they shall be watered, or, failing this, that one of the two following alternatives should be adopted:—

(1) Either a damp press cloth be placed over the load in the box,
(2) Or a damp sponge be worn over the worker's mouth.

Slip-house.

In the slip-house the raw materials of the "body" are ground and mixed together in a wet state, and afterwards put through a filter-press from which they emerge in cakes or lumps of clay ready for plastic treatment.* In some cases the use of a filter-press is dispensed with and the mixture of clay and water is run into a "slip kiln," *i.e.*, a large open bath with fireclay bottom and sides, and flues underneath for heating, and the water is driven off by evaporation until the right consistency for plastic working is reached. Before grinding begins water is, as a rule, added, so that the process is a wet one throughout, and no dust arises unless particles of the mixture are allowed to dry on the floor and are afterwards disturbed by passing feet; it is, therefore, only of importance that the floor should be kept thoroughly clean.

The present special rule requiring all floors to be sprinkled and swept daily includes slip-houses, but for these anything in the nature of general sweeping is wholly unsuitable. Various members of the Committee have personally looked closely into this matter, and it is thought to be essential that the process of cleaning should always be a wet one and constantly applied. The advisability of requiring it to be carried into effect *daily* was also submitted to careful enquiry, but, in view of the very different methods employed throughout the trade in slip-house work, this was not considered necessary; it was regarded as immaterial whether the floors were actually cleaned each day or not, if they were kept thoroughly clean, and it was therefore considered that the best form of rule would be as follows:—

"The floors of slip-houses shall be kept thoroughly clean by mopping or swilling."

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* For additional processes in the case of clay intended for tile-making, see page 55.

Dry Grinding.

In some potteries, on the other hand, where coarse ware is manufactured, the Committee have seen the materials ground in a dry state, which necessarily does give rise to dust; they consider therefore that under such circumstances either

(1) An efficient exhaust draught should be provided which will remove all dust generated so that it cannot be inhaled by the workers; or

(2) The grinding should be done in a machine so enclosed as effectually to prevent any dust escaping.

The Committee recommend that a rule to this effect should be incorporated in the modified code of regulations applicable to coarse ware potteries.

Wedging and Pugging of Clay.

After the lumps of clay are taken from the filter press, they are apt to contain air bubbles which it is necessary to remove. In the manufacture of china, this effect is obtained by a manual process known as "wedging"; each lump of clay is roughly cut into two equal portions, one of which is raised at arm's length in the air and forcibly brought down on to the other, the process being repeated until all the bubbles have disappeared. In the manufacture of earthenware, however, the necessity for hand labour may be largely averted by means of machines known as pug-mills, as the "body" lends itself to mechanical treatment which is unsuited to the clay from which china is made. It is very desirable that a pug-mill, or a "rolling machine," such as is occasionally employed for the same purpose, should be used wherever the nature of the clay admits of the practice.

But even after the clay has been pugged and rolled, it is sometimes found that the air bubbles have not been driven out with sufficient thoroughness. It has, therefore, also to be "wedged" to some extent, but naturally under these circumstances the work is comparatively light, as the bulk of it has already been done by the machines.

Where pug-mills or rollers are not in use, the work of wedging necessarily involves considerable strain, and, according to medical evidence, ill-effects, such as lateral curvature, are likely to arise from handling too large a lump of the clay. Several witnesses also testified to the danger of *lifting* and *carrying* heavy weights, and their arguments, which will be found summarised under the next heading, *i.e.*, "Clay Carrying," are equally applicable to the "wedging" process.

The latter is, therefore, wholly unsuitable for very young workers of either sex, and is almost certain to prove harmful to women, unless they are exceptionally strong. This conclusion has indeed already found expression in the Report of the Potteries Committee issued in 1893. It is therein stated that

> "The 'wedging' of clay should not be done by lads under 13 years of age, nor by girls under 16. It is very unsuitable labour in all respects for females."

None the less, no official action has as yet been taken in the matter, and the Committee have learnt that at certain factories very young workers of both sexes are given this work to do. They therefore recommend the adoption of a regulation in the following terms:—

> Wedging of clay,* which has not been pugged or rolled, shall not be done by any person under the age of 18, except male workers who wedge clay only for their own use.
>
> No woman shall be allowed to do such wedging unless the occupier has obtained from the Certifying Surgeon a certificate specifying her fitness for this work.

Clay Carrying.

The clay, being now ready for use, has next to be conveyed to the benches at which it is pressed into shape, and in almost every case it is carried by the pressers' attendants, who are usually young boys and girls.

* The term "wedging of clay" shall not be taken to include the process known as "slapping of clay," when two pieces of clay each small enough to be held in one hand are slapped together.

Numerous instances have been brought to the personal notice of the Committee in which the weight of clay carried is so excessive as almost certainly to prove harmful. Evidence to the same purport was given by factory inspectors, one of whom stated that a boy, who only weighed 63 lbs. himself, was known to have carried a lump of clay of as much as 70 lbs. How far such a weight exceeds all reasonable bounds will be readily appreciated when contrasted with the carrying power of such young workers, which was estimated by the medical witnesses as one of between 10 lbs. and 20 lbs.

Sub-employment.—The abuse is largely attributable to the system under which the attendants are appointed; they are not, as a matter of fact, in the actual employment of the manufacturers, but in that of the pressers, who work by the piece, and according to present custom themselves engage and pay them.* Naturally the youngest who are at all capable of doing the work are selected, because they can be hired at a lower wage; it would appear, moreover, that it is to the advantage of the presser to have the clay brought to him in as large lumps as possible, and hence it follows that the carrying powers of the attendants are constantly overtaxed.

Such sub-employment is very prevalent in potteries, more so, according to both the lady inspectors examined, than in other trades; it was, further, pointed out that it had the additional disadvantage of being subversive of good discipline, and the President of the China Manufacturers' Association, Mr. Plant, admitted that in this respect the control of the firm was deficient; some members of the Committee consequently regard the system with grave disapproval, but it must be admitted that on the whole both manufacturers and workers are opposed to any change. Mr. Bailey (of Doulton and Co.) called attention to the loss of control which it would occasion on the part of the piece-workers, and the point appeared to weigh strongly with the workers' representatives. Although the Glasgow operative witness and others of them spoke of evils which arise from the present system, the General Secretary of the National Amalgamated Society of Male and Female Pottery Workers, stated that his Union had no objection to it. Several manufacturers said they considered sub-employment to be indispensable; some even contested the inspectors' view that the system was a bad one, and Mr. William Burton summed it up as "a mixed evil, hindrance of discipline being considered."

The Committee, therefore, do not consider that they can offer any suggestions for the abolition of sub-employment, but desire strongly to point out that it is the duty of manufacturers seriously to concern themselves with its ill-effects. Mr. Maling explained, it is true, that they bring no pressure to bear on the attendants to induce them to carry too great a weight, but this is not sufficient; they ought to see that the evil is absolutely prevented. Some of the leading firms have, indeed, already taken active measures to cope with it; at the Worcester Royal Porcelain Works, for example, no girl, and only one boy—a youth over 16 years of age—is given any work of this description; at Messrs. Doulton's it is prohibited for any boy or girl to carry clay at all, and, since the enquiry was opened, Messrs. Johnson Bros. have adopted similar regulations.

But it is by no means a general practice for the firm to interfere, and it cannot be too clearly understood that, with regard to the provisions of the Factory and Workshop Acts, the responsibility for the well-being of the attendants rests, in the first instance, with the occupier on whose premises they work, and not with the piece-worker who actually engages them. Before the former could claim any exemption from the legal consequences of a breach of the Acts, he would have to prove that it was committed without his knowledge, and that he had exercised due diligence in ensuring the observance of the prescribed requirements.

Such being the facts of the case, the question arises how the abuse of overtaxing the strength of attendants may most effectively be prevented. Fortunately the necessary powers have already been provided, and to some extent applied. In Section 63 of the Factory and Workshop Act, 1901, which affects potteries as well as all other factories in the United Kingdom, it is enacted that a young person under

* This was stated in evidence both by employers and workers. See evidence of Messrs. H. J. Johnson, Bailey, Plant, Massey, and others; also Messrs. Lovatt, C., E., and Mrs. F.

the age of sixteen years, or a child must not be employed for more than seven, or, if the Certifying Surgeon for the district resides more than three miles from the factory, thirteen work days, unless the occupier of the factory has obtained a certificate, in the prescribed form, of the fitness of the young person or child for employment in such factory.

In Section 64 of the same Act, power is further given to the Certifying Surgeon to qualify the certificate by conditions as to the work on which a child or young person is fit to be employed, and, if it is so qualified, the occupier is prohibited from employing the young person or child otherwise than in accordance with the conditions imposed.

Dr. Hill, the Certifying Surgeon for Tunstall, has freely exercised the power of qualifying his certificates by specifying that the person examined must not carry more than so many pounds weight: it does not appear that the majority of the Certifying Surgeons in pottery towns have been in the habit of doing this, and it was pointed out to the Committee, by factory inspectors and others, that a definite rule on the subject was desirable. Dr. Alcock and Dr. Shufflebotham considered that a limit of weight, with periodical re-examination of the worker by the Certifying Surgeon, would meet the case. The latter precaution was also advocated by H.M. Principal Lady Inspector, but the present District Inspector at Stoke dissented from it.

Section 3 (4) of the Employment of Children Act, 1903, provides that "a child shall not be employed to lift, carry or move anything so heavy as to be likely to cause injury to the child," but this enactment relates only to the employment of persons under 14 years of age, and is therefore of very limited application in potteries.

Under these circumstances, in order that the evil may be adequately dealt with, the Committee recommend that a rule be framed as follows:—

> Girls under 16 and boys under 15 shall be prohibited from carrying clay; except that a boy under 15 who is working for himself and is not an attendant of another worker, shall be allowed to carry such clay as is to be used by himself in making articles.
>
> Female young persons over 16 and male young persons* over 15 shall only be allowed to carry such weights of clay as the Certifying Surgeon may certify to be reasonable in each case.
>
> No such certificate shall permit the carrying of more than 30 lbs. of clay by any young person under 16.
>
> All persons with regard to whom such certificates have been granted shall be re-examined by the Certifying Surgeon twice in the first period of six months, and once in each period of six months thereafter, until they attain the age of 18.

The Committee also consider that some similar rules should be applied to every process of carrying, lifting, or other heavy systematic work in which young persons are employed, and are further of opinion that, whenever practicable, mechanical contrivances—such as barrows and lifts—should be used for the conveyance of clay and other weighty material. There is ample reason for believing that the employment of such methods would save much manual labour in this connection and, in all probability, would prove to be more economical. They therefore recommend that:—

> No young person or child shall be employed in systematic carrying or lifting work without a certificate from the Certifying Surgeon specifying what weight the person in question may carry, having due regard to the nature of the proposed employment.
>
> No such certificate shall permit the carrying of more than 30 lbs. by any person under the age of 16 years.
>
> The rule as to re-examinations shall apply as in the case of clay carriers.

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* A young person is defined by Section 156 of the Factory and Workshop Act as a person who has ceased to be a child and is under the age of eighteen years.

Potters' Shops.

"Potters' shops" is the generic term applied to the workrooms where the clay is moulded, and the different classes of workers employed in them are as follows:—

1. Throwers.
2. Turners.
3. Jiggerers.
4. Jolliers.
5. Flat pressers.
6. Hollow-ware pressers.
7. Casters.

1. *Throwers.*—The "thrower" takes a ball of clay and shapes it with his hand while it is revolving on the potters' or throwers' wheel. He employs an attendant, called a "baller," who weighs out balls of clay of the size required for each article; as a rule, also, the baller takes each article as it is shaped and puts it on a board ready to be placed in the drying stove. In many cases the throwers' wheel is driven by mechanical power, but where hand-power is still in use, a second attendant, called the "wheel-turner," is employed. These attendants are often women, and the Committee, in the course of their visits to potteries, noted that in order to turn the wheel, it is necessary to lean considerable weight on the crank of a big driving pulley—an operation which is somewhat laborious.

They, therefore, advocate the following rule:—

> Females shall not be employed as wheel-turners for throwers unless they have been examined by the Certifying Surgeon and certified by him as fit for such employment, and the Certifying Surgeon may note any person so examined for a re-examination at a later date.

2. *Turners.*—The work of a "turner" consists in imparting a better finish to newly moulded articles of clay by turning them on a lathe after they have been partially dried. With earthenware, the lathes are almost always driven by machinery, but it was clearly pointed out in the evidence of leading manufacturers* that all attempts to introduce such motive power when making china have, owing to the nature of its body, proved unsuccessful. The alternative method of driving lathes is by employing an attendant to "tread" them, and this, according to several of these witnesses, is popularly believed to be a healthy occupation; the work is, however, done with the right foot on the treadle and the weight of the body resting on the left leg; the strain is not a heavy one, but, although the evidence was not of a decided character, it was suggested by some of the medical witnesses that the constancy of it might tend to cause physical trouble.

Whether, however, the attendant be woman, girl, or boy, some precaution appears to be advisable in order to obviate the possible risk, and in the view of the Committee a limit of age should be enforced under which it should not be permissible to employ them on this work. Such a restriction was, indeed, suggested by the Potteries Committee of 1893, who stated in their report that "The work of lathe treading should be disallowed for young persons under 16 years of age," and, although as yet no steps have been taken to render it compulsory, the evidence given before the Committee was on the whole in favour of a rule being passed to make it so. Dr. King Alcock, it is true, did not think an age limit would be of great value, but H.M. Principal Lady Inspector advocated one of 18 or 20 years, with periodical examination by the Certifying Surgeon, and Dr. Arlidge and Dr. Folker regarded treading lathes as unhealthy work for girls under 20 or 21 years of age. Mr. Plant, also, thought a limit of 16 years would be beneficial, and, as President of the English China Manufacturers' Association, stated that the firms he represented would willingly accept it. Both he, however, and Mr. Woolley, who spoke on behalf of the same Association, were opposed to extending the limit beyond this age, owing to the difficulty it would entail of getting apprentices and learners.

Particular consideration was also paid to the danger which lathe treading

* See evidence of Mr. Evans (of the Worcester Royal Porcelain Co.), Mr. Massey (of E. Hughes & Co.), Mr. Plant (President of the English China Manufacturers' Association), and Mr. Bailey (of Doulton & Co.).

might presumably cause to pregnant women. Doctors and manufacturers agreed that their exclusion would be desirable, but regarded it as difficult to enforce. H.M. Principal Lady Inspector undertook to collect particulars on the point, and carried her inquiry into effect, partly in person and partly through members of her staff; the conclusions at which they arrived are set out in full in Appendix XXVII. but, so far as their investigation went, it failed to disclose any definite proof of ill-effects either on child-bearing women or their families.

The Committee, therefore, recommend the adoption of the following rule, viz.:—

That no person shall be employed as a lathe-treader under the age of 16 years.

3. *Jiggerers.*—The "jiggerer" is a worker who uses his hands or a hand tool in shaping articles, but makes use of a jigger, that is to say, a vertical spindle driven by mechanical power, on the end of which is fixed a mould which revolves in a horizontal plane.*

4. *Jolliers.*—The "jollier" also uses a jigger, but shapes the clay by pressing against it a tool known as a "profile" which is fixed to a lever, so that it can be pulled down, and thus brought into contact with the clay as it revolves.*

5. *Flat Pressers.*—The "flat presser" shapes dishes, plates, saucers, and other articles which are technically termed "flat," as distinct from "hollow" ware. His business is to press down on to a mould a flat slab of clay of suitable thickness, called a "bat," and work it until it is in complete and close contact with the moulds, flutings, or other relief designs.

6. *Hollow-ware Pressers.*—The "hollow-ware presser" is a worker who shapes hollow ware, that is to say, articles such as jugs, ewers, etc.; he generally uses two half moulds, presses a "bat" on each, trims it off, and finally joins the two halves together.

7. *Casters.*—The work of a "caster" is to take clay which has been mixed with water to a creamy consistency, and pour the fluid thus obtained into a porous mould; the solid matter sets slowly on the inner surface, and after a certain time the remainder of the liquid is poured out, leaving behind the clay article as a deposit in the mould.

There are, besides, numerous subsidiary processes in the potters' shops, such as the making of handles for cups and jugs, spouts for teapots and the like, but it may be taken that all these are similar in nature to one or other of those which have just been described.

In all these shaping processes innumerable scraps of clay are inevitably scattered on the floor, which, when allowed to dry and to be trodden under foot, create considerable quantities of dust; the air, in consequence, becomes impregnated with it, and it is inhaled by the workers to the detriment of their lungs.

It is, therefore, most essential that the floors of potters' shops should be kept in a thoroughly clean condition, and, effectually to attain this object, they must in themselves be good and sound; where practicable, it is desirable that they should be actually impervious, and in any case it is imperative that the dirt should be removed by a moist method rather than a dry one.

These points were clearly brought out in the evidence of all the Factory Inspectors examined, as well as by the General Secretary of the Amalgamated Society of Pottery Operatives. To this view leading manufacturers also assented, while Mr. Joseph Burton dealt somewhat in detail with the methods which he had found, in his experience, to be most satisfactory for carrying out the moist cleaning of floors. The evidence pointed to a sprinkling with wet tea-leaves, saw-dust, or similar material, being desirable wherever practicable.

It was further generally agreed that the present rule should be retained in so far as it provides that the work of cleaning potters' shops shall be carried out by an

* Colloquially, the names "jiggerer" and "jollier" are frequently used as interchangeable terms.

adult male at a time when they are not otherwise being used. Mr. Walmsley, the late District Inspector for North Staffordshire, however, arguing on the assumption that the floors would be merely sprinkled with water and swept, maintained that the rule needed strengthening by a provision that the shops should be cleaned before midnight, on the ground that if the job were postponed until later, the dust would not have time to settle. Mr. Johnson, on the other hand, asked on behalf of the manufacturers, that they should not be required to complete it until 3 a.m., so as to facilitate the work in big potteries where a night staff is employed. In support of this claim he pleaded that if a really moist process of cleaning were adopted, so little dust would be disturbed that there would be ample time for it to subside before the workers began to arrive in the morning.

The Committee desire to call attention also to various preparations of heavy residual oils for application to wooden floors; experience seems to show that these tend to prevent the distribution of dust into the air.

Attention was called in evidence to yet another point, namely, the importance of scraps of clay being removed as promptly as possible. This was confirmed also by members of the Committee, who, in the course of their visits to potteries, noticed the tendency of such scraps to give off dust when handled, especially if the room be warm, and other conditions such as conduce to rapid drying.

In a few china factories, also, it is customary to sprinkle flint dust on the boards on which newly-made clay articles are carried from the potters' shops. H.M. Principal Lady Inspector called attention to this practice and advocated its control, but manufacturers contended that any restriction of this use of flint would be impossible without serious injury to the quality of the best china made. Members of the Committee have given personal attention to this matter, and they feel that, while it should be impressed both on manufacturers and workers that the greatest care is needed in handling such flint dust, they do not consider that it would be possible to issue any regulation with regard to its use.

The Committee therefore recommend the following three rules:—

Floors.—In all potters' shops there shall be provided and maintained:—

Either impervious floors;

Or, wooden floors with a thoroughly smooth and sound surface, constructed in such a substantial manner as to be free from permanent sag, and maintained in such repair that they can be properly cleaned by a moist method, and that no dust can fall through into rooms below.*

Daily cleaning of floors.—The floors of all potters' shops shall be thoroughly cleaned daily, by a moist method, by an adult male after work has ceased for the day, and before 3 o'clock the next morning.

Removal of scraps, etc.—Scraps of clay and other débris, including any which have collected under benches, shall not be allowed to accumulate unduly, and the occupier shall cause all such scraps and débris to be damped and carried out at least once a day.

Work Benches in Potters' Shops.

The necessity of keeping the work benches clean was carefully considered, and both inspectors and manufacturers advocated the adoption of a wet method for this purpose. To facilitate the operation it was pointed out that the surfaces of the benches should be both smooth and impervious, and one manufacturer held that those made of hard wood were preferable to any other. Metal coverings were strongly recommended by the operatives' representatives, and Mr. Walmsley and Mr. Massey spoke of the use of zinc coverings with quite satisfactory results. Mr. Bailey was, however, of opinion that this metal was likely to injure the ware, and submitted that sheet lead, though free from this tendency, had the disadvantage of being more costly. Mr. Joseph Burton and Mr. H. J. Johnson also deprecated the use of zinc, and the former stated that he had found a surface which can be scraped wet to be preferable in many cases to one which must be washed.

* In many cases the laying down crosswise of a second set of floor boards tongued and grooved, would be the simplest way of meeting the case.

With regard to the proper time for the operation, the present rule enjoins that it shall be carried out once a week. The Committee, however, consider that the benches should be cleaned every day, and after carefully weighing all the different suggestions offered, recommend that—

> Work benches, if not covered with sheet metal, or constructed with an impervious surface, shall be strongly and solidly constructed of closely jointed timber, and the surface of the work benches shall be well maintained.
>
> All work benches shall be thoroughly cleaned daily by a moist method.

Mould-making.

It will have been noticed from the foregoing paragraphs that most articles of pottery are shaped on or in moulds. These are cast from plaster of Paris, and some dust is given off in handling the material, especially when sacks of plaster are emptied into the bin provided for its storage in the mould-making shop.

No precise evidence was submitted to the Committee to prove whether this dust was actually dangerous, and none of the medical witnesses had heard of any definite ill-effects directly attributable to it. Dr. Legge, however, stated that if much of this dust were inhaled bronchitis might result, and Sir Thomas Oliver held a similar opinion in respect of all soft dusts.

Members of the Committee have carefully observed the handling of plaster of Paris in mould-making shops, and conclude that the following rule will be a sufficient safeguard against the possible risks involved:—

> An exhaust draught shall be provided to prevent the escape of plaster of Paris dust into the air, except in those cases where the bin is provided with a cover and the material is conveyed in a sack, the mouth of which is tied and only loosened after it has been placed in the bin.
>
> Where a covered bin and tied sack are in use and no exhaust draught is provided to prevent the escape of plaster of Paris dust into the air, the worker shall wear a simple respirator, such as a potter's sponge, across the mouth and nostrils, during the time that he is emptying the sack of plaster into the bin; such a respirator to be supplied to each worker and maintained in a cleanly condition by the occupier.

Storage of Moulds when not in use.

Attention was called by one of the manufacturers, Mr. Ridgway, to the great difficulty of properly cleaning the floors of potters' shops on which spare moulds are allowed to accumulate. The dust, collecting on these heaps, is disturbed by every vibration of the floor, and is dispersed into the air of the room. Mr. H. J. Johnson agreed that it is preferable to have such spare moulds kept outside, and the workers examined all urged the provision of a mould chamber, with a man in attendance to carry the moulds to and fro as required. Mr. Bailey dealt at some length with the objections to the proposal, emphasising the risk of time being lost to a serious extent.

The Committee have given the matter careful consideration, but find on examination that in many factories there is no free space available for the purpose within a reasonable distance of the potters' shops; it does not, therefore, seem possible to require the erection of a separate chamber in every case, but it is believed that the full observance of the rules for cleanliness of potters' shops will necessarily put a stop to any undue accumulation of spare moulds on the floors or work-benches. On the other hand, it must be admitted that the storage of such moulds on the tops of stoves is objectionable, inasmuch as they become thickly coated with very dry dust, and, when disturbed, disperse it into the air. The Committee therefore recommend a general rule to the effect that:—

> Suitable provision shall be made for the storage of all moulds when not in use, and the tops of drying stoves shall not be used for this purpose, unless such places are boarded up to form cupboards.

Drying the newly made Clay Articles.

After being shaped by one of the processes just described clay articles are put aside—moulds and all—to dry, and certain kinds, which do not need to be dried rapidly, are simply placed on racks in the general workroom; in this there is an element of danger; the moisture, drawn out of them, tends to make the room damp, and in such cases it is essential that the workers should be protected by proper ventilation. The question, however, is part of the larger one of efficient general ventilation which is fully dealt with on pages 117-9.

All the other clay articles are transferred, together with their moulds, to chambers artificially heated by a coal stove put in the centre of the floor, or by a battery of steam-pipes, and, in the warmth, the moisture in the clay more or less rapidly evaporates; these chambers are accordingly known as "drying" stoves, and are of the following different kinds:—

1. The *stillage room*, or ordinary potters' stove, which is simply a heated chamber fitted with racks, called stillages. On these are placed the boards which carry the clay-ware.

2. The *two-sided dobbin*, consisting of a reversible door, pivoted vertically in the middle. It stands between the workroom and a heated chamber, and, on either side, it is fitted with shelves which, when facing the workroom, are filled with the boards and their load of clay-ware; the door is then reversed; the ware is thereby transferred to the heated chamber, and as soon as it is sufficiently dry the process is repeated with a fresh supply. It will be noted that with this apparatus there is no need for the workers to enter the heated space.

3. The *four-armed dobbin* practically consists of two doors similar to those of the two-sided dobbin, bisecting one another. The opening between the heated chamber and the workroom is so arranged that three-quarters of the dobbin face towards the former, whilst the remaining one quarter presents itself as a V-shaped cupboard facing the latter. As each quarter is filled, the dobbin is pushed round one quarter of a revolution, and the next section filled, or emptied and refilled, with moulds and ware.

The most prevalent evils in this department come under the following headings:—

(*a*) The dust generated in the drying stoves.
(*b*) Want of proper ventilation.
(*c*) Overheating of workrooms adjacent to the drying stoves.

(*a*).—All the evidence regarding the importance of keeping the floors of potters' shops clean and free from débris applies with even greater force to those of stillage rooms. Owing to the heat, the pieces of clay-ware which fall about rapidly become extremely dry, and their tendency to promote dust is therefore the more pronounced, if they are liable to be trodden under foot.

Much of the dust, arising from scattered scraps of ware, could be averted by placing broken articles and other waste clay in suitable receptacles; Mr. Duckering* suggests the provision of boxes for this purpose.

The drying-stoves when heated by steam-pipes need special attention. The pipes are frequently arranged in a horizontal plane only a few inches above the floor, and cleaning under them is thus rendered impossible. It would obviously be an improvement if they were placed in a more suitable position.

In securing general cleanliness it is important that stoves and drying chambers should periodically be lime-washed; this is provided for in all factories by section 1 of the Factory and Workshop Act, 1901, except in places exempted by order of the Secretary of State. The Committee think that this requirement should be strictly enforced in regard to drying stoves entered by workpeople.

(*b*).—Particular emphasis was laid, in the evidence, on the want of proper ventilation in drying stoves, and the necessity of their being made to communicate directly with the open air; the desirability of this was urged alike by medical men, factory inspectors, manufacturers, and operatives.

Owing to defective building, there is frequently a constant escape of hot and moist air from the drying stoves into the workrooms, and, under the present

* One of H.M. Inspectors of Factories, whose services were specially placed at the disposal of this Committee for a series of tests with the object of determining the amount of dust in the air of various workrooms.—See Appendix XLIX.

system of heating, the danger due to it has become much aggravated; at one time, the pot stove was almost universally used for the purpose; it maintained a draught of air from the drying chamber up the flue, and consequently assisted ventilation, but it has now largely been replaced by steam-pipes, which afford no such advantage.

The present rule requires that all drying stoves shall be effectually ventilated to the reasonable satisfaction of the inspector in charge of the district, but this provision does not appear to be strong and definite enough to secure its proper observance. All the factory inspectors, who were examined, stated that rules definitely setting forth the requirements are much to be preferred in practice to those which leave a great deal to the discretion of individual inspectors. The Committee accordingly recognise that it is very desirable to avoid the latter type of regulation as far as possible.

(*c*).—Of the various "drying stoves" in use, dobbins are admittedly the best type as being least detrimental to the health of the workers. All such stoves are, however, equally open to the objection that the heat they generate makes the workrooms to which they are adjacent hot to an excessive degree, and ought to be effectively screened off.

This object the Committee believe could best be attained by means of partitions either made of brick or of two layers of wood with an air space between them, and so arranged as to ensure the temperature in the workrooms being kept within a given limit as indicated by a wet-bulb thermometer. In principle this proposal was accepted on behalf of the manufacturers, but it was contended that brick walls could not always be built, and that in some instances all that could be done would be to mend the old wooden partitions.

The Committee accordingly, after reviewing the whole question of drying newly made clay articles, recommend the enforcement of the following requirements:—

Floors.—The rules set forth on page 50 for securing cleanliness of the floors of potters' shops shall apply to all drying stoves which are entered by workers.

When steam pipes are used for heating a drying stove, the best position for them is in the form of a rack of horizontal pipes fixed in a vertical plane. Where this is impossible, the pipes shall be arranged in such a position as to allow a thorough cleaning under and around them.

All stillages shall be sufficiently above the floor to allow a thorough cleaning under them.

Boxes shall be provided for the reception of pieces of broken or waste clay ware.

Ventilation—(*a*) All workrooms in which clay or other articles including moulds, are left to dry shall be suitably ventilated in such a way that the moisture arising from the articles is carried away from the workers. See General Ventilation, page 117.

(*b*) All drying stoves shall be ventilated direct to the outside air by shafts having upward inclinations and terminating vertically, or by louvres in the roof, or by other efficient means.

Temperature.—The condition of the atmosphere in the workroom shall not be such as to cause the reading of the wet-bulb thermometer to exceed 70° Fahrenheit, unless at such times as the reading of the wet-bulb thermometer in the shade in the open air exceeds 65° Fahrenheit.* For the purposes of this regulation the term "workroom" shall not be deemed to include any stove or drying chamber which is only entered by workers for the purpose of carrying ware in or out or turning it.

There may possibly be small branches of the trade where it will prove impracticable to carry out this rule; the Committee therefore recommend that the Secretary of State should reserve power to grant exemptions in the case of any such branch of the industry, provided it can be shown that every means has been tried for reducing the temperature so as to conform to the prescribed limit.

* The Committee, in suggesting a limit of 70° F., have had regard to the fact that the processes carried on, if due attention is paid to ventilation, are such that little moisture need escape into the general atmosphere of the workplaces.

The evidence on which the Committee have based the above temperature rule applies generally to many other departments of potteries, and will be found fully reviewed on pages 119-20 of this Report.

Fettling.

After being moulded, the clay article has to be "fettled," that is to say, trimmed and finished, for which purpose it is almost invariably given to an attendant who works in the same room; frequently the clay is in a "green" state, or in other words still contains a great deal of moisture, and does not therefore throw off any dust; but many articles have to be dried sufficiently to reach the condition known as "White hard" before they are fettled; under such circumstances the operation does give rise to dust, especially if, as constantly happens, the desired effect is produced by applying a tool to the clay as it revolves on a power-driven "jigger."

Fettling with damp materials, such as a sponge, does not give rise to any dust, and both factory inspectors and operatives drew attention to the advantage of such a practice. For the dry fettling, on the other hand, of "white hard" ware, the provision of an efficient exhaust draught for the removal of dust was strongly advocated, and in the edging of flat ware, even if the operation is performed by spongers, *i.e.*, fettlers who spend more than half their time in smoothing the surface of ware with a wet sponge*—the necessity of similar protection when dust is generated, was specially emphasised by several witnesses. In this view the manufacturers examined generally concurred, but they desired the exclusion of hollow ware from any rule dealing with dry fettling, on the ground that with such articles the amount of dust produced is not dangerous.

Towing.—Towing is a special method of fettling which is applied to earthenware in order to give it a first-class finish. Each article is put on a mechanically driven jigger and revolved rapidly, while the worker holds a piece of material, such as tow, against the ware, and so imparts to it a smooth surface. For this operation the clay ware must be "white hard," and therefore gives rise to large quantities of dust while being towed.

Provision for the removal of dust during this operation by an efficient exhaust draught has been required by each successive code of rules since 1894, and Dr. Legge testified to the great improvement in the conditions of health which has resulted from their introduction. Of the value of exhaust fans in dealing with dusty processes generally there is no question, and thirteen witnesses, including manufacturers, operatives, medical men and Home Office officials bore witness to their paramount importance. Mr. Pendock,† however, who made an enquiry on behalf of the Committee into the present condition of such apparatus, reported that grave defects were to be found in almost every installation which he examined, and a second inspector spoke of the difficulty of getting such apparatus brought up to the highest standard.

It was further shown in evidence that when the rules regarding "towing" were originally framed only earthenware articles were subjected to the treatment. To-day, in some factories, it is also applied to china, and the operatives' representatives urged the necessity of the same precautions being insisted on where this was the practice. Mr. Redgrave, H.M. Superintending Inspector of Factories, endorsed this recommendation, which was agreed to by Mr. Plant, the President of the English China Manufacturers' Association.

On the whole, the rules at present in force appear, apart from extending them to china, to be in no need of revision. It is essential, however, that the exhaust apparatus should be kept in a thoroughly effective condition, and this is evidently not being done at the present moment. In dealing, therefore, with the general question of ventilation at a later stage in this Report, attention

* Mr. Duckering reports that, on an average, twenty minutes of each hour is devoted to the dusty process of "edging" and forty minutes to that of "sponging," which is free from dust. See Appendix XLIX.

† The services of Mr. Pendock, one of H.M. Inspectors of Factories, who has had great experience in matters of ventilation, and was secretary of the Departmental Committee on Ventilation in Factories and Workshops, were placed at the disposal of this Committee for a considerable period in 1908-9. For his report see Appendix XLVIII.

will be called to the unsatisfactory features in the exhaust installations now provided in many of the potteries, and recommendations will be made for securing a much higher standard of efficiency in future.

Sand-sticking of Sanitary Ware.—Large articles of sanitary ware, such as lavatory basins, are frequently finished with the aid of a long, straight piece of wood, to which a piece of sandpaper has been attached. This instrument is worked up and down their edges like a file, so as to produce a level and smooth face. The articles must generally be fairly dry before the sandstick is applied, and the operation is therefore productive of a certain amount of dust.

Attention has been called both by operatives and factory inspectors to the need of an exhaust draught to remove the dust generated in this process. Representatives of the manufacturers agreed that, when the operation is a dusty one, it should be dealt with as suggested.

After the fullest consideration of the various forms of fettling, the Committee recommend that the rule relating to them should make the provision of an efficient exhaust draught compulsory in the following cases:—

1. The fettling of flat ware, whether china or earthenware, by towing or sandpapering. Provided that this shall not apply to the occasional finishing of pieces of china or earthenware without the aid of mechanical power.
2. The sand-sticking of sanitary ware.
3. Any other process of fettling on a power-driven machine, except where
   (*a*) The fettler is fettling only his or her own work as an occasional operation, or
   (*b*) The fettling is wholly done with a wet sponge or other moist material.*

Tile-making.

For the manufacture of tiles with a white body the same material is used as for that of earthenware, namely, a composite clay, containing ball clay, china clay, flint, and stone. The manner in which these ingredients are mixed together has already been described, under the paragraph headed "Slip-house," but the cakes of clay, after being taken from the filter press or the slip-kiln, instead of being used in the wet state, are put in a heated chamber to dry. By this means a sufficient proportion of the moisture which they contain is driven off, and they are next reduced to powder in a machine known as a disintegrator.† This powder, which is not absolutely dry, but just damp enough to bind, is then sifted, and by means of a very powerful screw press—and by this pressure alone—is converted into tiles; these in turn are fettled by rubbing the edges with a piece of flannel, sandpaper, or other material. Unless the clay dust is originally very moist, there is a considerable dispersal of it into the atmosphere at each of the above-named stages in the manufacture of tiles, and from this point onward they are treated in the same way as any article of pottery which has been made by a plastic process. Tiles are also made in a similar way from coloured clays, and many other articles, such as certain portions of electrical fittings, are also made by the compression of dust.

With regard to disintegrators, one of the employers explained how the escape of dust could practically be prevented by the provision of an outlet from the box in which the powdered clay is deposited, sufficient to secure the maintenance of a current of air from the surrounding atmosphere, and an operative tile maker gave similar evidence. The Committee have also made observations for themselves, and believe that the use of an efficient disintegrator should not be attended by the escape of any considerable amount of dust, and that the chief dangers to be guarded against are—

(*a*) The oozing out of dust through cracks and badly-fitting joints in defective apparatus; and

* Turning and polishing on a lathe are not included in the term "fettling." Tile fettling is dealt with in a separate rule.

† Occasionally an open grinding machine is used for this purpose: in such cases the Regulations suggested on page 45 for "dry grinding of clay" would be applicable.

(*b*) The blowing out of dust from the disintegrator into the room by reason of a back pressure within the machine, due to the absence of a proper outlet for air from the box into which the pulverised material is delivered.

The Committee are of opinion that these points, as well as the considerations set forth on page 45 under the heading of "Dry Grinding," could be met by a general regulation to the following effect:—

The dry grinding of materials for pottery bodies shall be done either with an efficient exhaust draught for the removal of dust, or in machines so enclosed as effectually to prevent the escape of dust; except that it shall not be deemed necessary in pursuance of this regulation to provide an exhaust draught to remove small amounts of dust given off at the hopper of an enclosed machine in the course of feeding the same, if an outlet into an exhaust duct or to the outside air is fitted to the receptacle into which the powdered material is delivered.

In the course of the evidence attention was directed to the grave risk of lung trouble which is incurred by workers in the more dusty processes of tile-making. With regard to these, exhaust fans have already been introduced into one or two tile factories with most encouraging results, and many witnesses advocated their universal use. The pressing and fettling operations were spoken of as specially calling for such means of clearing the atmosphere, and its application to that of sifting was also recommended. The only exception suggested to this view was in respect of the sifting of very damp clay dust, such as is used for certain varieties of tiles.

Evidence was also given with regard to the danger of dust being inhaled while the material is being carried from the storage bins to the work-benches on which the presses are erected. In this connection the Committee can only recommend that a rule be drafted in general terms, and that tile manufacturers be called upon to give careful attention to the adoption and maintenance, in each individual case, of such a system for the conveyance of material to the press-workers as will best achieve the object in view, viz., the avoidance of dust. As already stated, the clay dust is slightly damp, and it is quite possible to empty a box of it on to a work-bench without dispersing much into the air of the room if sufficient care is exercised. To attain this object it is only necessary to observe simple precautions, such for example, as holding the box in its inverted position for a few moments before lifting it off. The dryness of the dust used at different factories appeared to vary greatly, and the Committee suggest that it should, in every case, be used as damp as practicable.

Mr. Duckering* mentions the use of sacks, in place of boxes, for carrying clay dust to the tile-presses; this, as he points out, results in much dispersal of dust, and should be prohibited.

The Committee accordingly recommend the following rules in regard to the various dusty operations in the manufacture of tiles:—

Sifting of clay dust shall be done either

(*a*) With the aid of an efficient exhaust draught for the removal of dust, or

(*b*) In a machine so enclosed as effectually to prevent the escape of dust,

unless the material sifted is so damp that no dust can be given off.

In each tile press shop there shall be provided an efficient exhaust draught installation, with an opening connected with each press in such a way as effectually to remove the dust generated in the pressing process.

Every tile fettler shall work at an efficient exhaust opening, unless fettling is done wholly on or with damp material.

Supplies of material shall be conveyed to the work benches in such a manner as to disperse as little dust as possible into the air.

Clay dust shall not be carried into any tile-making shop in sacks.

All these regulations shall apply equally in all places where articles other than tiles are made by the method of compressing powdered clays, unless the clay is so damp that no dust is given off.†

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* See Appendix XLIX.

† As is the general practice in the electrical fittings branch of the trade.

Biscuit Placing.

In the manufacture of many varieties of cheap pottery, such as stoneware and the like, the ware—as soon as it has been moulded and fettled—is simply dried in the clay state and at once passed on to the dipping house to be glazed. But all ware of a higher order is first subjected to an initial firing, i.e. baking, from which it emerges in a state known as "bisque" or "biscuit"; for this purpose it is put into fire-clay boxes or "saggers," and the operation is technically termed "biscuit placing."

This operation is carried out almost exclusively by men, and in the process earthenware and china are, with a few exceptions, treated differently.

With ordinary earthenware, if "hollow" in form, but slight difficulty arises, as it has only to be placed in such a position as to enable it to retain its shape; but if "flat," there is considerable likelihood of its bending or warping, and, when in this form, it is generally embedded in sand to give it the necessary support.

Sir Thomas Oliver, who believes all dust to be dangerous, spoke in his evidence of this process as involving some risk; but Dr. Legge was of the contrary opinion, on the ground that the amount of dust generated was infinitesimal, and no evidence was put forward to show that any rule with regard to this use of sand is required.

With china, on the other hand, and some special varieties of earthenware, great risk is involved in "biscuit placing." Instead of sand, such ware, when "flat," is embedded in powdered flint, and even when "hollow" has the same material sifted over it. In either case the process is highly dangerous; each particle of flint dust, having sharp angles, is apt to penetrate and damage the delicate lung tissue, and almost every medical witness spoke of it as the most dangerous dust to which workers in potteries are exposed.

Obviously, therefore, it is essential to afford them all possible protection against it, and no fewer than 16 witnesses, including medical men, manufacturers, operatives, and factory inspectors advocated the necessity of installing exhaust fans for its removal. Mr. Massey and Mr. Plant, both china manufacturers, pointed out certain difficulties attending their application, but the Committee, after visiting several factories where exhaust draughts are in use, do not regard such difficulties as insuperable.

But in addition to the effect of flint dust on the lungs being extremely serious, it is in its action very insidious, and in its early stages proportionately difficult to detect.

On this account the advisability of subjecting all placers who work with flint to a periodical medical examination was strongly urged by four* of the medical witnesses, but while all of them were in agreement with the principle of the proposition it was generally admitted that there was no need to enforce it as frequently as once a month. It must also be pointed out that such examinations would be useless unless accompanied with powers to suspend from work, and, seeing that those employed in processes not involving contact with lead have no claim to the compensation to which lead workers are entitled, their suspension would constitute a genuine hardship. The matter, therefore, involves special considerations which will be found fully reviewed under the heading "Compensation" on page 104.

Evidence was also given pointing out the necessity of keeping the floors clean in all biscuit-placing shops: to facilitate this, the use of a hard impervious material, such as blue brick, was advocated, and attention was called to the importance of keeping the floors in good repair.

In respect of biscuit placing, the Committee accordingly recommend:—

That the processes known as bedding and flinting, when the ware is embedded in powdered flint, shall not be carried on without the use of an efficient exhaust draught for the removal of dust.

The Secretary of State shall reserve power to establish, by Order, a system of yearly examination by the Certifying Surgeon, with power of suspension, at any time when he is satisfied that a scheme can be simultaneously put into operation whereby those suspended shall receive reasonable compensation for loss of employment.

In all biscuit placing shops an impervious even floor of brick, flag, or similar hard material shall be provided, and shall be kept in good repair; it

* Three of these witnesses were Certifying Surgeons for North Staffordshire towns in which china potteries are located.

shall be thoroughly sprinkled and swept by an adult male at least once daily, namely, when the work of setting in an oven has ceased, or at the end of the day's work.

Setting in and Firing the Biscuit Oven.

The saggers containing the ware to be fired are next carried into the oven and there piled up in columns, each successive sagger forming, so to speak, the lid of the next below. These columns are technically known as "bungs," and the process is called "setting in" the oven.

The doorway by which access is gained to the oven during the setting in process is then bricked up with temporary brickwork called "clammings," and all round the oven fires are lighted in the fire-holes.

After a proper temperature has been reached,* and maintained for a sufficient time, the fires are drawn, the clammings knocked out, and the oven with its contents allowed to cool.

Drawing the Biscuit Oven.

Temperature.—When the temperature has fallen sufficiently, the oven is entered by a team of men who carry out the saggers, with the ware they hold.

This operation is known as drawing the oven, and much evidence was given before the Committee concerning the exposure to excessive heat which it involved. The temperature is naturally highest at the top, and the man who hands down the topmost saggers is the one who is most likely to suffer from the heat.

He does not, however, work continuously at this part of the job, as the men change places with one another, and each does his share of it. Mr. Elkin, representing the Dippers' and Oven-men's Union, stated that a man at the top would need to be relieved after a spell of work lasting between a quarter and half an hour, but he considered that it would not be practicable to impose a rule limiting the period that any man might continue to work in the greatest heat.

Mr. Elkin further spoke of various means devised with the object of expediting the process of cooling; he advocated, for example, the use of "back clammings," that is to say, sections of temporary brickwork near the top and at the sides and back of the oven, the knocking out of which establishes a through cross draught from the ordinary clammings in the front and all the fire-mouths; he also instanced the provision of special "cooling dampers" on the crown of the oven; in many factories such devices are already fitted, but they are far from being universally adopted; the absence of such provision, he claimed, was largely the cause of the cooling being delayed. Mr. H. J. Johnson stated that at his works many of these devices are in use, and he strongly advocated that everything possible should be done to accelerate the cooling of ovens.

Mr. Elkin, again, stated that the evil was often due to mismanagement; the ware is constantly delayed in its progress through the various stages of its manufacture, and does not reach the oven-men at the time when they are ready to begin setting in; they have to wait about, frequently for several hours, with the inevitable result that they are behind time: the firing consequently begins several hours later than should be the case, and in order to get the ware out punctually when required, the time allowed for cooling has to be curtailed. Occasionally, moreover, as one manufacturer stated, special orders are received at such short notice that, if they are to be executed up to time, it is impossible to avoid unduly hastening the drawing of an oven.

Several of the operative witnesses further testified to the ill-effects noted as a result of exposure to high temperatures in this work, and their evidence was entirely corroborated by the observations of factory inspectors.

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* The temperature reached at any given time is ascertained by various methods, such as—

1. "Trials," *i.e.*, small pieces of earthenware dipped in a glaze which changes colour according to the temperature reached. A number of "trials" are placed in the oven near a hole left for this purpose, and are withdrawn one at a time at intervals to ascertain the progress of the firing.

2. "Bars," which consist of strips of compressed mixed silicates of varying fusibility carried on a frame which supports their ends only; at a certain temperature the first strip bends and the others in turn follow suit as the temperature rises; by the time the fourth or fifth strip begins to sag the first one has probably collapsed altogether.

3. "Cones," of similar material, which bend over at the apex.

4. Electric pyrometers, which indicate the temperature by the change in the electrical resistance of a wire, or by means of a thermo-junction.

A number of medical witnesses also spoke strongly with regard to the risks incidental to work in temperatures exceeding a certain limit, which they placed variously at from 70° to 120° Fahrenheit, and two of the largest manufacturers expressed themselves as in favour of anything that could be done to reduce the evil.

Two members of the Committee specially conversant with oven work, viz., Mr. Moore and Mr. Edwards, respectively representing the manufacturers and the workers, undertook a special investigation of this question, and as a result the Committee are in a position to recommend the following rule as likely to prevent any serious risk arising in connection with this operation in future:—

> The temperature, whether taken at the bottom of the stage where the top drawer stands, or at any lower stage where men are working, shall not exceed 125° Fahrenheit.
>
> In the case, however, of any oven in which—
>
> (*a*) cooling dampers are in use, and in respect of which
>
> (*b*) there has been no unnecessary delay in setting in the oven,
>
> it shall be permissible, on the joint agreement of employer and employed, to suspend the above rule not more than four times in any period of twelve months; but such suspension of the rule shall be conditional on immediate notice being sent to H.M. Inspector of Factories for the District, stating the name or number (for which purpose every oven provided with cooling dampers shall be named or numbered) of the oven which is being drawn at a temperature exceeding 125° Fahrenheit, taken as above.
>
> When notice is given by the oven-men, whether directly to the manager or occupier, or by handing it in to the office before 5.30 p.m., to the effect that the oven-men wish to have the temperature tested before the oven is drawn next day, the firm shall arrange to have a responsible representative present for the purpose at the time when the drawing in question commences.
>
> The temperature of ovens shall also be taken, on a demand being made by the oven-men, at any time when they are engaged in drawing.

The Committee are very strongly of opinion that any exercise by oven-men of their right, under this regulation, to require the temperature to be taken, should not be allowed to prejudice their employment; and further, that if they cease drawing until after the temperature has been taken, such action on their part should not be used as the basis for proceedings for breach of contract.

Dust.—Mr. Duckering's observations* show that there is, in respect of china, some exposure to flint dust in the course of carrying out the newly-fired ware from the oven; this is especially the case when, as occasionally happens, broken saggers have to be handled. The operation is not one which can be dealt with by exhaust fans, but the risk is not continuous, and would probably be sufficiently provided against if the men themselves will voluntarily wear some simple form of respirator, such as a sponge, when handling broken saggers or others from which an appreciable amount of dust is emanating.

Handling of Biscuit Ware after Firing.

Earthenware Placed in Sand for Biscuit Firing.

Sand is, as already described, almost exclusively used as the bedding material for British earthenware. Very little dust therefore arises from the subsequent operations of removing ware from the saggers, emptying sand out of the saggers, and stacking the ware in the biscuit warehouse.

Brushing of Earthenware Biscuit.—A certain quantity of sand, however, adheres to the ware, and has to be brushed off. In some cases this is a very intermittent process carried on by the warehouse workers, who are mostly women; but in some large factories it constitutes practically the sole employment of certain women and girls, who are therefore constantly exposed to the risk of breathing the dust.* At the same time, the process does not always lend itself to the application of localised exhaust, and the Committee do not find it possible to define the cases in

* Mr. Duckering's experiments show that under such conditions the amount of dust inhaled may be considerable. See Appendix XLIX.

which such provision would be practicable. While, therefore, they are not inclined to regard general ventilation, even when mechanically effected, as in any sense equivalent to the local removal of dust by exhaust draughts, they feel compelled in this case to recommend that the manufacturer should be left a choice between the two alternatives, and that:—

> The brushing of earthenware biscuit shall be done in front of an efficient exhaust opening for the removal of dust, unless the process is carried on in a room provided with efficient general mechanical ventilation.

China and such other Ware as is placed in Powdered Flint for Biscuit Firing.

The various operations connected with china and other ware for which powdered flint is used in "biscuit firing" are as follows:—

Emptying ware from saggers.
Emptying flint from the saggers.
Flat-knocking.
Fired-flint-sifting.
Emptying baskets for scouring.
Scouring.
Fine brushing.
Batting.

Emptying such biscuit ware from the saggers.—This operation is solely entrusted to men, and as a rule they are only employed on it for one full day a week. If the articles are hollow-ware over which flint dust has been sifted, as stated on page 57, or even if they are flat ware "flinted," *i.e.*, separated by layers of the powdered material but not fully packed in it at the sides, it appears that the articles can be removed from the saggers, after firing, without much dust being evolved; but with "bedded" flat ware the sagger is completely filled with powdered flint, and the process is shown by the results of Mr. Duckering's air tests* to be one of the most dusty in the whole range of the pottery manufacture; sometimes it takes place at the mouth of the oven, and this, it is true, acting to some extent as a chimney, creates a strong current of air which carries much of the dust away; but the remainder is blown all about the workers' faces, and as it is impracticable to provide a local exhaust draught for its removal, an appreciable quantity of it must be inhaled. In some factories, however, it is the custom before emptying the saggers of bedded flat ware to transfer them to a bench beyond the range of the oven draught, and, since it is obvious that the practice ought to be generally adopted, the Committee recommend that:—

> Biscuit flat ware which has been bedded for firing, by being placed in saggers and completely covered with powdered flint, shall not be removed from the saggers after firing, except at a bench fitted with an efficient exhaust appliance for the removal of dust.

As, however, the application of such a rule will involve a material change in the methods at present in vogue in many potteries, the Committee suggest that reasonable time be allowed to elapse before it is made operative.

Emptying Flint from the Saggers.—When the ware has been taken from the saggers in which it has been fired, a considerable amount of powdered flint is left behind; in emptying this, whether into a box, known as an "ark," or into the hopper of a sifting machine by which it will be conveyed into the ark, a certain amount of dust is necessarily generated, but the operation, which is done by men only, is of such short duration that the Committee do not feel that they need recommend a rule to deal with it; in many cases, however, the dust could without difficulty be effectively removed by means of a branch duct from some existing exhaust installation, and the attention of manufacturers who make china or other ware which is bedded in flint, should be called to the desirability of providing some such protection.

Flat-Knocking of China Biscuit Ware and Flint-Sifting.—It is often the custom to take piles of the flat articles which have been embedded in powdered flint and shake out the dust by knocking their edges on a leather pad. The flint dust thus dislodged, as well as that emptied direct from the saggers, is afterwards sifted in order to be used again.

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* See Appendix XLIX.

The present rule dealing with these processes reads as follows:—

> Flat-knocking and fired-flint-sifting shall be carried on only in enclosed receptacles, which shall be connected with an efficient fan or other efficient draught, unless so contrived as to prevent effectually the escape of injurious dust.

Many witnesses emphasised the necessity of dealing adequately with the dust generated in these processes, and it was pointed out that both for flat-knocking and flint-sifting, automatic machines were at present in use which satisfactorily answered the purpose. The Committee, therefore, consider that the rule as it stands is both practical and, if fully observed, sufficient to ensure proper conditions. In view, however, of Mr. Duckering's report,* as well as from their own observation, they hold that the rule should be more strictly enforced than has hitherto been the practice; the crude methods still prevailing in certain works should no longer be permitted to continue; while reasonable time should be given to make the necessary alterations, all existing apparatus should be brought into full compliance with the regulation as laid down, and where handwork is retained the exhaust draught installation should, if necessary, be improved and maintained in a thoroughly effective condition.†

It should also be pointed out that in some factories the fired flint is handled unnecessarily often, as, for example, when a sagger is emptied into a box or barrow and the latter afterwards emptied into the sifting apparatus; much dispersal of dust could be obviated if manufacturers would so organize the work as to ensure that the dangerous materials be handled as little as possible.

Emptying Baskets for Scouring.—All articles after being fired in powdered flint are found to have particles of it adhering to their surface, and have in consequence to be thoroughly cleaned or scoured; usually, therefore, the men who take them from the saggers put them into baskets in or near the oven, and carry them thence to the scouring shop; but there the baskets are as a rule handed over to women to empty: in some factories the work is done by scourers unaided, but in many they are assisted by additional women, known as "biscuit emptiers."

Many of these biscuit emptiers are employed as "casual" hands in the sense that they are engaged on successive days in different factories, but most of them probably work about four days per week in all. Some danger attaches to their occupation on account of the dust produced, and one witness proposed the use of an exhaust draught apparatus for this operation; the attention of manufacturers was called to this suggestion, but they considered it to be one quite impossible to carry into effect, and as no practicable scheme for the provision of such apparatus has been put before the Committee, they are unable to recommend it.

Some precaution is, however, beyond doubt necessary, and the need for it has already, if somewhat ineffectually, been officially recognised. There is at every factory a book kept called the Health Register, in which are entered the names of all workers who are required to undergo monthly medical examination, and it is provided by the rules, which have been in force since 1901, that in this book the names of all biscuit emptiers shall be registered; they are, however, under no orders to appear before the Certifying Surgeon for periodical examination, and the registration is consequently of no avail.

To put an end to this anomaly, a number of witnesses, including factory inspectors and certifying surgeons, urged the importance of subjecting all biscuit emptiers to such medical examination, but, as mentioned in connection with the process of biscuit placing, it was generally agreed that once every month was more frequent than necessary: Dr. Legge suggested a half-yearly period, and several other doctors one of two or three months.

The Committee agree that biscuit emptiers ought to undergo periodical medical examination, but consider that once a year will be quite often enough. Their actual proposals on the subject, seeing the similarity of the two processes, are included in their recommendations relating to "biscuit scouring" with which they next deal.

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* See Appendix XLIX.

† An experimental machine has lately been introduced for flat-knocking, which is likely to prove very efficient.

Scouring of biscuit ware which has been fired in flint.—The process of biscuit scouring is a very important one in the manufacture of china, and is invariably the work of women and young persons. Previously the operation was performed without any mechanical assistance by means of hand brushes and sandpaper, but for both methods machine-driven jiggers have been almost universally used during the last ten years: in the one case the revolving jigger carries a brush, bristles upwards, and the article is scoured by being pressed upon it; in the other, the article itself is placed on the jigger, and, as it rotates, pressed with sandpaper. But whether performed with or without the help of machinery, the above operations produce a great deal of dust, and since 1898 the rules have required the provision of exhaust fans or other efficient means for its removal.

Further, within the last few years two new methods of scouring have been introduced:

1. *The sand-blast method:* when used, this apparatus is wholly enclosed, and the worker's arms pass through sleeve holes, which fit closely enough to prevent the escape of any dust, and the article to be scoured is held in front of a jet of sand which is projected against it by compressed air.

2. *The rumbler method:* for this, the articles to be scoured are ranged in racks which in turn are placed inside a big drum, together with a small quantity of bits of broken ware which are free to tumble about without restraint; the drum is made to revolve, and the moving fragments clean the articles by friction. The dust set up in the drum would prevent the machine from doing its work well, and, in order to remove it, the axle is made hollow and connected with an exhaust fan.

Factory inspectors and manufacturers alike spoke of the material improvement in conditions effected by the introduction of the "sand-blast" and "rumbler" machines, and the Committee would be glad to see these or similar appliances in universal use. They do not think it would be expedient to frame any specific rule on the subject, but in all china factories the saving in labour involved and consequent economy appear to be so great, that they believe the early substitution of such machines for the older methods is assured.

Attention was drawn by one witness to certain subsidiary processes connected with the use of the rumbler machines, notably the filling of the racks with ware, for which some form of local exhaust draught appeared desirable, but manufacturers who have had experience of these machines pointed out the difficulties of its application. The Committee, after personal observations made by some of the members, have formed the opinion that the dust generated in these subsidiary operations is not sufficient to require any special rule to deal with it.

The rules of 1898 enjoin a monthly medical examination of all women and young persons employed in china scouring, and grant power to the certifying surgeon to suspend workers when necessary. It should, however, be noted that as in the case of biscuit placers, such suspension affords scourers no claim for compensation,* and the hardship which it constitutes (see page 57) equally applies to both classes of workers. In respect, indeed, of the latter, the anomaly appears to be even less reasonable. According to Mr. William Burton's evidence it was intended to include them in the optional compensation scheme of 1901-3, and they were only omitted because of an oversight in drafting the final terms of it for submission to Lord James of Hereford.

From the official Table of Suspensions* submitted by Dr. Legge, it is satisfactory to note that extremely few scourers appear to be sufficiently affected to be stopped from work; so long, however, as there are any, the necessity for periodical examination must be regarded as established, and this conclusion is further supported from a general point of view by other statistics which have been collected.†

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* See Appendix XXVIII.

† Classification of scourers, compiled by Dr. Arlidge, Certifying Surgeon for Stoke, Fenton and Longton—see Appendix XXIX.; also tables drawn up by H.M. Principal Lady Inspector of Factories—see Appendices XXX, XXXI, and XXXII.

The Committee, therefore, while recognising the unfairness of suspension without compensation,* consider that it would be a retrograde step to discontinue such examinations altogether, pending an extension of the provisions of the Compensation Act, and accordingly recommend that they shall be continued but not at such short intervals. On this point there was some diversity of opinion among the medical witnesses, and Dr. Prendergast of Hanley was in favour of adhering to the practice of holding them every month; but, as explained with reference to the danger of inhaling flint dust, under the heading of "Biscuit Placing," other doctors considered that longer periods would suffice.

After considering the question with regard both to the removal of any flint dust likely to be inhaled and to the need of medical examination, the Committee recommend:—

> That the scouring of ware which has been fired in powdered flint—whether done entirely by hand or with the aid of power-driven jiggers or other apparatus which is not so enclosed as effectually to prevent the escape of dust—shall not be carried on without the use of an efficient exhaust draught for the removal of dust.
>
> That all scourers or emptiers of biscuit ware, which has been fired in powdered flint, shall be medically examined by the Certifying Surgeon for the district at least once in every twelve months, the Surgeon to have the same powers of suspension as at present.
>
> That some scheme shall be devised whereby those suspended shall have reasonable compensation for loss of employment.

Fine Brushing.—In some instances the ware after being scoured by machinery is not sufficiently clean, and has to be "fine brushed," *i.e.*, to undergo a final brushing by hand.

It was stated in evidence that fine brushing is not, as a rule, required for ware that has been passed through a rumbler, but that the practice is still adopted in most factories in which open scouring jiggers are in use. A considerable amount of dust is generated in the process, and both factory inspectors and employers emphasised the need of an efficient exhaust draught for its removal.

In 1901 at the arbitration proceedings before Lord James of Hereford, fine brushing was accepted by Mr. Brough, one of the Counsel appearing for the manufacturers, as coming within the definition of china scouring, but none the less the Committee in their visits to china factories have frequently found it in operation without any provision being made for local exhaust; they therefore recommend the insertion of a clause in the rules to the effect that:—

> Fine brushing is to be regarded as scouring for the purposes of all rules relating to the latter process.

Batting.—Biscuit ware which has been fired in flint is sometimes put aside for a time before it is needed for the subsequent processes of printing† and glazing‡. During this period it becomes dusty, and it is frequently the custom to clean it by "batting," *i.e.*, by striking it smartly with a wad of tissue paper. The process is productive of a considerable amount of dust, which consists principally no doubt of the general dust of the room, but also contains an appreciable amount of fine particles of flint.

Factory inspectors and manufacturers are entirely in accord as to the desirability of an efficient exhaust draught for removing the dust generated in batting; Mr. Walmsley, who was the Inspector in charge of North Staffordshire from 1892 to 1907, secured the provision of exhaust fans for this process throughout his district by exercising the powers conferred by Section 74 of the Factory and Workshop Act, 1901§; if, however, the necessity should arise of enforcing the last-named section by legal proceedings, it would be requisite to call medical evidence in each case to prove that the dust is injurious; to avoid this somewhat cumbrous method of procedure, it is desirable to embody the requirement in question in the Special Regulations for potteries.

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* See "Compensation," page 104.

† See page 85.

‡ See page 67.

§ Requiring the use of exhaust fans in any process generating injurious dust, even when not dealt with by any special rule.

The Committee therefore recommend that:—

The "batting" of biscuit ware which has been fired in flint shall be included in the list of processes for which an efficient local exhaust draught is compulsory under the Regulations.

Stopping of Biscuit Ware.

When large pieces of sanitary ware, and certain other articles, notably those included in the terms "figure-work" and "flowering," are taken from the biscuit oven, cracks are frequently found which have to be filled up with a material known as "stopping." This commonly consists solely of "ground pitcher," *i.e.*, powdered pieces of broken ware, mixed with water to the consistency of a thick paste, but occasionally a little white lead or glaze is added, which is obviously a source of danger.

The evidence showed that the operation is an important one, but that usually, in high-class figure-work, only the man himself who makes the article uses the stopping, and that merely for some twenty minutes in each day; among such there is no record of any resulting illness, but one or two women have been reported as suffering from poisoning due to the presence of lead in the stopping material. More commonly, however, the "stopping" used by women is of a non-poisonous character, and the Committee think that, as a practical rule, the following will suffice:—

The stopping of biscuit ware, if more than 5 per cent. of soluble lead is used in the stopping material, shall only be done by an adult male.

This work shall not be deemed to be employment in a process included in the Schedule of dangerous processes.*

Additional Processes for Decorated Ware.

This concludes the processes in the manufacture of ware, whether plain earthenware or china, up to the point at which it is ready to receive its coating of glaze. Decorated ware, on the other hand, before it reaches this stage, frequently goes through additional operations, of which printing* is far the most important. Most of the decorative processes, however, whether the patterns be applied before or after the ware is glazed, are carried on in more or less the same manner, and it will therefore be convenient to deal with them later under a separate heading.

GLAZE PROCESSES.

Before proceeding to examine the various processes connected with the manufacture and application of glaze, it will be well to make two observations which in each case affect the Committee's recommendations. These are as follows:

1. For practically every process the Committee consider it to be necessary that the workers employed therein should wear overalls, should undergo medical examination once a month, and should be provided with proper mess-rooms and lavatories. It will, therefore, be simpler to treat these essentials separately; they are, accordingly, dealt with later under their respective headings, and will not be included, except when any modifications of them are requisite, in the recommendations which the Committee make for each individual process.

2. It will readily be understood that leadless glazes, and glazes of 5 per cent. solubility or under, are far less noxious than the ordinary raw lead glazes, and that consequently it is unnecessary that the dust arising from them should be subjected to such stringent regulations. The recommendations, however, of the Committee must be so framed as to cover all glazes; for those, therefore, containing no lead, or only a small percentage of soluble lead, exemptions will have to be made, but there will be no need for reiterating the reasons for so doing; they will consequently be recorded without further comment.

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* See page 97.
† See page 85.

MANUFACTURE OF GLAZES.

Many manufacturers purchase their glaze ready prepared and ground; others prepare and grind it themselves, and the lead compound to be used, whether carbonate or oxide, is received at the pottery in casks and kept there till it is required. When a "charge" of glaze, as it is called, is to be made, a certain quantity of this lead compound is weighed out and mixed with the necessary silicates and silico-borates*. If the glaze is to be one of raw lead, the operation takes place in the lead-house, and the mixed materials are shovelled direct into a machine in which they are ground in a wet state. If, however, a fritted lead glaze is being made, it is almost always the custom to provide a mixing room quite distinct from the lead-house; the lead compound, mixed with a portion only of the other ingredients, is transferred to the bed of the frit kiln; thence, after firing, it emerges as lead frit in a stream of liquid glass, and is received into a tank generally containing water, in which it solidifies; the rest of the ingredients are then added, and the whole ground together in a wet state, just as in making a raw lead glaze. The men employed in both these processes have also to attend to further operations such as lawning and magneting† the glaze, which indeed occupy the greater part of their time; but once the materials are mixed, the risk of inhaling lead dust practically ceases, and such subsequent stages in the manufacture of the glaze may therefore be regarded as much less hazardous. The danger is more concentrated and prolonged in the case of the few men who mix the materials for making lead frits, because they are handled at long intervals in large quantities and the mixing has to be more thorough, whereas raw lead glazes are mixed and ground generally speaking once or twice a week in small "charges," the weighing out lasting only a quarter of an hour or so each time.

Since 1901, the rules have, at the suggestion of the manufacturers, excluded women from the operations of weighing and mixing the raw materials of lead glazes, and require that all men employed on them should wear respirators. Since 1903, moreover, it has been compulsory for all men working in the lead-house to be medically examined every month. Notwithstanding these precautions, however, the number of cases of lead poisoning arising in this department of potteries has not, as the following table shows, been reduced since 1904:—

NUMBER OF CASES OF LEAD POISONING PER ANNUM FROM 1899 TO 1909 AMONG MILLERS AND MIXERS OF GLAZE EMPLOYED IN POTTERIES (including a few Colour Mixers).

Number employed (return of 1907) - - Males, 371; ‡ Females, 55; total, 426.

Year.	Number of attacks. Males.	‡ Females.	Total.	Rate of attacks per 1,000. Males.	‡ Females.	Total.
1899	9	—	9	24	—	23
1900	4	1	5	11	48	12
1901	6	1	7	16	48	18
1902	5	1	6	13	48	14
1903	4	—	4	11	—	9
1904	4	—	4	11	—	9
1905	8	2	10	22	95	25
1906	4	1	5	11	48	12
1907	5	1	6	13	48	14
1908	8	—	8	22	—	19
1909	4	—	4	11	—	9

Dr. Legge spoke strongly of the dangers of lead-house work, and advocated the use of exhaust fans to remove the dust generated in weighing out and mixing; he considered that they should be applied in the same way as is done in paint and colour works under the present rules 1 and 2, which read as follows:—

Paint and Colour Regulations.

Rule 1.—"No lead colour shall be placed in any hopper or shoot without an efficient exhaust draught and air guide so arranged as to draw the dust away from the worker as near as possible to the point of origin."

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* See page 5.

† Magneting is the name given to the operation of removing particles of iron from a glaze by passing it through a magnetic field produced by permanent or electro-magnets.

‡ Particulars regarding females are included in this table because in the Home Office records no distinction has been attempted between the processes in which, as above stated, the employment of women and young persons has been forbidden since 1901, and others, such as grinding and mixing of finished colours, in which women may still be employed.

Rule 2.—"No lead process shall be carried on, save either:

"(*a*) With an efficient exhaust draught and air guide so arranged as to carry away the dust, or steam, as near as possible to the point of origin; or

"(*b*) In the case of processes giving rise to dust, in an apparatus so closed as to prevent the escape of dust."

It appeared, however, on investigation, that the cost of such an installation would be very great, and as, moreover, there was some room for doubt whether the adoption of such stringent measures in lead-houses and mixing rooms was generally necessary, Dr. Legge was recalled for further examination on the subject. In reply to questions put to him, he could not speak definitely as to the efficacy of respirators, but thought it quite possible that they might serve to counteract the danger. The Committee have therefore come to the conclusion that in all operations of shovelling, weighing and mixing the materials for making glaze, it will be sufficient at the present moment to provide for the general use of such respirators; if on further trial such a safeguard proves to be inadequate, the question may with advantage be reopened, and the advisability of installing exhaust draught apparatus in lead-houses and mixing rooms again brought forward for consideration.

It must, moreover, be remembered that the work in question is of an extremely intermittent character, fresh "charges" of raw glaze being dealt with at most once or twice a week, and fritted lead glazes in larger quantities perhaps only every three or six months. It is also customary in many places to purchase the lead compound with 5 per cent. or 10 per cent. of moisture added to it so as to make it damp, and the evidence shows that its tendency to give off dust is thereby greatly reduced. The rules, accordingly, which the Committee recommend are as follows:—

> Unfritted lead compounds, such as white lead, red lead or litharge, used in the making of frits or glazes, shall not be handled except with at least 5 per cent. of added moisture.
>
> They shall, further, be kept in their original packages until weighed out, and the tub or other receptacle containing them shall be so fitted, either with a cover or a damp screen, as to prevent the issue of any lead dust from its mouth.
>
> In the weighing out, shovelling, or mixing of unfritted lead compounds, where an efficient exhaust draught is not provided to prevent the escape of dust into the air, no person shall be employed without wearing a simple respirator, such as a damp sponge of the kind generally used by potters; and no person shall be allowed to work, without wearing such a respirator, in a room where such weighing out, shovelling, or mixing has taken place, until at least 30 minutes have elapsed after the weighing out, shovelling, or mixing has ceased.
>
> The floors of all lead-houses and mixing rooms shall be constructed and cleaned in accordance with the regulations recommended in respect of those of potters' shops.*
>
> A special lavatory basin, with a supply of hot and cold water, soap, towel and nail brush, shall be provided in the lead-house, in addition to the general lavatories.†
>
> The rule forbidding any but adult males to be employed in a lead-house should, of course, be retained, as well as other regulations as for dipping houses.
>
> *Exemptions.*—None of these rules relating to lead-houses and mixing rooms shall apply to a room in which leadless glazes only are made. With regard to low solubility glazes, seeing that the danger in handling the raw materials is unaltered by the fact that they are to be fritted subsequently into a comparatively harmless lead silicate, the full rules must apply to the lead-houses and mixing rooms of potteries or glaze-making works where such frits are prepared.

Dipping House Processes.

Lawning the Glaze.

The glaze is kept in large tubs or other receptacles until required for use, when it is taken to the dipping house; it is still, however, apt to contain particles of insufficiently ground material or aggregations of solid matter formed during its

* See page 50. † See page 110.

storage; before, therefore, being actually used by the dipper, these have to be removed, and the glaze is strained through a fine lawn sieve, a process which in some factories is carried out by means of an automatic machine, but more generally by hand by the dipper. The former method was considered to obviate part of the danger, and it was agreed that, if the operation is done by hand, no woman, owing to the likelihood of her being seriously splashed by the glaze, should be allowed to be employed on it.*

It was pointed out to members of the Committee when visiting tile works, that in many such places it is the custom for women to lawn glaze in small quantities for their own use; to this practice there do not appear to be the same objections as to the use of the large sieves common in ordinary earthenware and china factories, to which the evidence more particularly referred.

The Committee therefore recommend a rule as follows:—

Lawning of glazes, except where less than a quart of glaze is lawned at a time, shall be done by an adult male.

Exemption.—This rule should not apply to the lawning of either

(1) Leadless glazes, or

(2) Glazes which yield not more than 5 per cent. of soluble lead oxide when submitted to Dr. Thorpe's solubility test.

Dipping.

The glaze being ready for use, the biscuit ware is then immersed in it, the dipper, in this country, invariably holding it with his hand bare; each article, after being taken out, is generally swirled round to get rid of any excess of glaze, and put aside to drain or to dry.

The following tables show (1) The incidence of lead poisoning, taking the United Kingdom as a whole, among dippers in the various branches of the pottery industry from 1899 to 1908. (2) The incidence among North Staffordshire dippers from 1896.

(1) DIPPERS. Whole of United Kingdom (including North Stafford).

Number of persons employed.

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture, and Electrical Fittings.	Sanitary.	Totals.	Totals. M. and F.
1904—M.	93	478	119	18	35	5	33	781	913
F.	—	47	47	2	2	34	—	132	
1907—M.	107	456	125	17	30	8	43	786	936
F.	8	41	52	18	4	27	—	150	

Number of cases of lead poisoning.

	China. Cases.	China. Attack rate per 1,000.	Earthenware. Cases.	Earthenware. Attack rate per 1,000.	Tiles. Cases.	Tiles. Attack rate per 1,000.	Majolica. Cases.	Majolica. Attack rate per 1,000.	Jet and Rockingham. Cases.	Jet and Rockingham. Attack rate per 1,000.	China Furniture, etc. Cases.	China Furniture, etc. Attack rate per 1,000.	Sanitary. Cases.	Sanitary. Attack rate per 1,000.	Total cases.	Attack rate per 1,000.	Total cases. M.& F.	Attack rate per 1,000.
Under Special Rules from 1894.																		
1899—M.	5	54	30	63	2	17	1	56	—	—	—	—	—	—	38	49	55	60
F.	—	—	10	213	3	64	—	—	—	—	4	118	—	—	17	129		
1900—M.	4	43	20	42	5	42	1	56	5	143	—	—	1	30	36	46	41	45
F.	—	—	1	21	2	43	1		—	—	1	29	—	—	5	38		
1901—M.	2	22	11	23	4	34	—	—	1	29	1		—	—	19	24	23	25
F.	—	—	2	43	—	—	—	—	—	—	2	59	—	—	4	30		
1902—M.	—	—	9	19	2	17	—	—	—	—	—	—	—	—	11	14	15	16
F.	—	—	3	64	—	—	—	—	—	—	1	29	—	—	4	30		
1903—M.	—	—	11	23	2	17	—	—	2	57	—	—	1	30	16	20	17	19
F.	—	—	—	—	1	21	—	—	—	—	—	—	—	—	1	8		
Medical examination of men began.																		
1904—M.	1	11	15	31	4	34	—	—	—	—	—	—	—	—	20	26	28	31
F.	—	—	3	64	4	85	—	—	—	—	1	29	—	—	8	61		
1905—M.	1	11	11	23	—	—	—	—	—	—	—	—	—	—	12	15	16	18
F.	—	—	—	—	1	21	3		—	—	—	—	—	—	4	30		
1906—M.	4	37	14	31	5	40	—	—	—	—	—	—	—	—	23	29	28	30
F.	—	—	—	—	1	19	3	167	—	—	1	37	—	—	5	33		
1907—M.	4	37	14	31	—	—	—	—	—	—	—	—	3	70	21	27	27	29
F.	—	—	2	49	1	19	—	—	—	—	3	111	—	—	6	40		
1908—M.	1	9	15	33	2	16	—	—	—	—	1		1	23	20	25	27	29
F.	—	—	2	49	2	38	—	—	—	—	3	111	—	—	7	47		
1909—M.	1	9	12	26	1	8	—	—	—	—	—	—	—	—	14	18	18	19
F.	—	—	1	24	2	38	—	—	—	—	1	37	—	—	4	27		

* See page 113 for full report on the wider question of the exclusion of women from all lead processes.

(2) DIPPERS. North Staffordshire District only.

		Number of persons employed.	Totals.
1898	M.	495	576
	F.	81	
1900	M.	501	564
	F.	63	
1904	M.	481	566
	F.	85	
1907	M.	504	611
	F.	107	

Number of cases of lead poisoning.

		Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.
1894 Rules: Overalls, ventilation, sweeping, lavatories, &c., introduced.					
1896	M.	53	107	68	118
	F.	15	185		
1897	M.	48	97	57	99
	F.	9	111		
1898	M.	41	83	48	83
	F.	7	86		
1898 Rules: Monthly medical examination of women and young persons began.					
1899	M.	30	60	37	66
	F.	7	111		
1900	M.	30	60	33	59
	F.	3	48		
1901	M.	12	24	13	23
	F.	1	16		
1901 Rules: Lord James' first award; little change.					
1902	M.	5	10	6	11
	F.	1	12		
1903	M.	10	21	11	19
	F.	1	12		
1903 Rules: Lord James' final award; medical examination of men began.					
1904	M.	15	31	19	34
	F.	4	47		
1905	M.	10	21	14	25
	F.	4	47		
1906	M.	16	32	21	34
	F.	5	47		
1907	M.	17	34	21	34
	F.	4	37		
1908	M.	11	22	16	26
	F.	5	47		
1909	M.	12	24	15	24
	F.	3	28		

The attack rates shown in the above tables are somewhat high as compared with the average for all lead workers (see pages 96 and 97), but are less than those for dippers' assistants and ware cleaners. The risk in dipping appears to be due mainly to the dust arising from dried splashes of glaze, and from dry ware cleaning carried on in proximity to the dippers. It is significant in this connection that there have been no cases among Jet and Rockingham dippers during the last six years, although they plunge their hands into glazes containing more raw lead than is used for ordinary earthenware and china; this immunity has been explained partly by the small amount of "swirling" done at the moment of dipping, but is ascribed principally to the absence of dry ware cleaning, the articles being generally prepared for firing before the glaze on them is quite dry.*

One of the Certifying Surgeons stated that he had noticed a tendency to employ workers as dippers at too early an age, and as it is to be expected that when very young they have less power to resist plumbism, the present rule which for such employment prescribes an age limit of fifteen years, does not appear to be sufficiently stringent. Various witnesses, therefore, were in favour of raising the age limit to 18, 21, and even 25 years.

The Committee have taken into consideration the varying requirements of all branches of the trade, and recommend that:—

> No one shall be allowed to work as a dipper under the age of 18, except where glazes of 5 per cent. solubility or under are exclusively used, when the limit of age shall be 16 years.
>
> This rule shall not apply to dippers who use only leadless glazes.

Floors and Walls in Dipping Houses.

The danger, in dipping houses, of lead poisoning appears to arise largely from the splashes of glaze which after falling on the floor, walls, and sides of the tub, in due course become dry; when trodden on, brushed, or disturbed in any way, they give rise to dust, which permeates the atmosphere and is inhaled by the workers.

* The proportion of fatal cases (see Appendix X.) is larger among dippers than among ware cleaners, although the latter have a higher non-fatal attack rate; this is accounted for by the fact that dippers as a rule continue their occupation throughout life, and so have inhaled dust arising from their own and the ware cleaning operation continuously for many years, while the ware cleaners usually cease to work after only a few years' employment.

Where leadless glazes alone are used, or those of 5 per cent. solubility or under, the Committee consider that regulations similar to those recommended for potters' shops will suffice, but that with glazes containing a higher percentage of soluble lead, the cleaning of dipping houses needs special attention.

Floors.—All the factory inspectors examined emphasised the necessity of providing dipping houses with impervious floors which can be swilled down; many manufacturers and operatives also agreed to the proposition, and nearly all the medical witnesses held that such floors should be made compulsory for all lead departments.

The Committee are convinced that sweeping is quite unsuitable for a dipping house, and they recommend that:—

In all dipping houses, other than those where leadless glazes or lead glazes of solubility not exceeding 5 per cent. are exclusively used,* washable impervious floors, properly sloped towards a drain, shall be provided, and shall be thoroughly cleaned daily by an adult male, after work has ceased for the day, with a jet of water and a mop or similar implement.

Walls.—The splashes of glaze on the walls and other objects in the immediate neighbourhood of the dipping tub are due to the final swirl given, as stated above, by the dipper to each piece of ware just before it is set aside to drain; the glaze dries on the walls, and is rubbed off as dust by the clothing of any passing worker; Dr. Legge did not think the question of the walls so important as that of the floors, but others of the Inspecting Staff, as well as several medical witnesses, were in favour of their being made of washable materials.

The Committee therefore recommend that:—

In all dipping houses, other than those where leadless glazes or lead glazes of solubility not exceeding 5 per cent. are exclusively used, the walls adjacent to any dipping tub shall be tiled, or painted with washable paint, or otherwise treated in such manner as to permit of thorough cleaning by a wet process.

All walls on which splashes of glaze may fall, as well as the dipping tubs and any other objects which may be splashed with glaze, shall be thoroughly cleaned daily by a wet process.

Ventilation and Lighting.—It is obvious that there is the greatest need of rendering dipping houses thoroughly healthy both as regards ventilation and lighting, but in both respects it was pointed out that they are often very faulty.

Dr. Legge went so far as to advocate exhaust fans drawing from near the floor level to assist the general ventilation; the Committee, however, do not think that such installations should be made compulsory in all dipping houses; they may be necessary in some instances in order to secure the requisite purity of the atmosphere, but good natural ventilation will generally suffice, if careful attention is given to the principles laid down later under that heading.

As regards lighting, Dr. Alcock and Dr. Hill pointed out the necessity of setting a high standard, while Dr. Legge considered that, in dipping houses especially, it was desirable that the direct rays of the sun should find access at some part of the day.

The Committee think it would be desirable to include in the rules a general requirement to this effect:—

Dipping shall not be done in places which, in ordinary fine weather, are dependent on borrowed light or on artificial light during the hours of daylight.

Dippers' Assistants.

There are two classes of dippers' assistants, viz.: (1) the attendants who hand the biscuit ware to the dipper, and are called "putters up"; (2) those who take the newly dipped ware from the dipper, and are called "takers off."

The latter class doubtless incur the greater risk, as they actually handle the article with the wet glaze on it; but both are equally exposed to the general risk of employment in the dipping house, viz., that arising from the breathing of dust which may be disseminated in the air from dried splashes of glaze. The same operatives, moreover, are frequently engaged in both kinds of work, and it has not been found possible to classify them separately.

The extent of the risk which has been incurred in the past by dippers' assistants may be gauged from the subjoined tables:—

* For recommendations applicable to the floors of glazing departments in potteries where leadless or low solubility glazes are exclusively used, see page 122.

(1) DIPPERS' ASSISTANTS. Whole of United Kingdom (including North Stafford).

Number of persons employed.

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture and Electrical Fittings.	Sanitary.	Totals	Totals. M. & F.
1904—M.	70	283	56	5	24	2	14	454	841
F.	5	315	21	5	28	6	7	387	
1907—M.	77	298	56	3	12	1	16	463	860
F.	5	283	50	7	24	21	7	397	

Number of cases of lead poisoning.

	China.		Earthenware.		Tiles.		Majolica.		Jet and Rockingham.		China Furniture and Electrical Fittings.		Sanitary.		Totals		Totals. M. & F.	
	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Total cases.	Attack rate per 1,000.	Total cases. M.& F.	Attack rate per 1,000.
Under Special Rules from 1894.																		
1899—M.	—	—	12	42	1	18	—	—	—	—	—	—	—	—	13	29	34	40
F.	3		17	54	1	48	—	—	—	—	—	—	—	—	21	54		
1900—M.	1	14	7	25	1	18	—	—	—	—	—	—	—	—	9	20	32	38
F.	—	—	19	60	—	—	—	—	—	—	4		—	—	23	59		
1901—M.	1	14	2	7	—	—	—	—	1	42	—	—	—	—	4	9	15	18
F.	—	—	7	22	—	—	—	—	—	—	4		—	—	11	28		
1902—M.	—	—	3	11	—	—	—	—	—	—	—	—	—	—	3	7	15	18
F.	—	—	11	35	—	—	—	—	1	36	—	—	—	—	12	31		
1903—M.	—	—	5	18	1	18	—	—	—	—	—	—	—	—	6	13	24	29
F.	—	—	17	54	—	—	1		—	—	—	—	—	—	18	47		
Medical examination of men began.																		
1904—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	20	24
F.	—	—	17	54	—	—	—	—	1	36	2		—	—	20	52		
1905—M.	—	—	4	14	—	—	—	—	—	—	—	—	—	—	4	9	19	23
F.	—	—	12	38	—	—	—	—	2	71	1		—	—	15	39		
1906—M.	—	—	4	13	—	—	—	—	—	—	—	—	—	—	4	9	23	27
F.	—	—	18	64	1	20	—	—	—	—	—	—	—	—	19	48		
1907—M.	—	—	1	3	—	—	—	—	—	—	—	—	—	—	1	2	14	16
F.	—	—	12	42	—	—	—	—	—	—	—	—	1		13	33		
1908—M.	—	—	6	20	—	—	—	—	—	—	—	—	—	—	6	13	25	29
F.	—	—	19	67	—	—	—	—	—	—	—	—	—	—	19	48		
1909—M.	—	—	1	3	—	—	—	—	—	—	—	—	—	—	1	2	10	12
F.	—	—	7	24	—	—	—	—	2	83	—	—	—	—	9	23		

(2) DIPPERS' ASSISTANTS. North Staffordshire District only.

Number of persons employed.

			Totals.
1898 - - - - - - - -	M.	518	625
	F.	107	
1900 - - - - - - - -	M.	386	595
	F.	209	
1904 - - - - - - - -	M.	334	573
	F.	239	
1907 - - - - - - - -	M.	368	625
	F.	257	

Number of cases of lead poisoning.

		Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000
1894 Rules: Overalls, ventilation, sweeping, lavatories, &c., introduced.					
1896 - - - - - - - -	M.	12	23	30	48
	F.	18	168		
1897 - - - - - - - -	M.	29	56	39	62
	F.	10	93		
1898 - - - - - - - -	M.	20	39	39	62
	F.	19	178		
1898 Rules: Monthly medical examination of women and young persons began.					
1899 - - - - - - - -	M.	10	26	26	44
	F.	16	77		
1900 - - - - - - - -	M.	8	21	23	39
	F.	15	72		
1901 - - - - - - - -	M.	4	10	14	24
	F.	10	48		
1901 Rules: Lord James' first award; little change.					
1902 - - - - - - - -	M.	3	9	12	21
	F.	9	38		
1903 - - - - - - - -	M.	5	15	19	33
	F.	14	59		
1903 Rules: Lord James' final award; monthly medical examination of men began.					
1904 - - - - - - - -	M.	—	—	16	28
	F.	16	67		
1905 - - - - - - - -	M.	4	12	16	28
	F.	12	50		
1906 - - - - - - - -	M.	4	11	19	30
	F.	15	58		
1907 - - - - - - - -	M.	1	3	9	14
	F.	8	31		
1908 - - - - - - - -	M.	6	16	19	30
	F.	13	51		
1909 - - - - - - - -	M.	1	3	7	11
	F.	6	23		

In a number of factories the work of dippers' assistants and ware cleaners is not kept separate, so that some of the cases in the above table might properly belong to that of the latter (see page 75) and *vice versâ.*

In this respect Dr. Legge, by whom the statistics are collected and tabulated at the Home Office, pointed out that the classification of any given case depends on the nature of the employment as specified in the Certifying Surgeon's report, and, although these medical officers are intimately acquainted with the work of potteries, it is not always possible for them to distinguish between two sets of operatives whose work overlaps as much as does that of ware cleaners and dippers' assistants.

It will be noted that attacks among female dippers' assistants, employed in the earthenware branch of the industry, are more than three times as numerous as those which occur among men; the average rates per cent., for the 11 years 1899 to 1909 inclusive, are respectively 4·7 and 1·4, and the marked difference between them is ascribed by the medical witnesses to the susceptibility of females at certain ages being much greater than that of males.

Attention was specially called in the evidence to the increase in the number of lead cases among dippers' assistants during times when pressure of work was greatest, and under existing regulations many dippers' assistants might certainly be too young to stand the strain. The present limit of age for their employment is 15 years, and two factory inspectors and a representative of the Amalgamated Society of Pottery Workers advocated raising it to 18 years. Other witnesses suggested 17 years and 16 years respectively. The manufacturers examined held that 16 years was sufficient, though one of them thought a somewhat higher limit might be desirable in the case of females.

The Committee have considered at great length the peculiar circumstances of the different branches of the trade; they anticipate, however, a great improvement in the health conditions of dipping houses as a consequence of the strict application of the rules proposed by them in regard to floors, ventilation, and other matters; they therefore think that an age limit of

17 for female dippers' assistants, and
16 for male dippers' assistants

will suffice to eliminate any exceptional risk of lead poisoning which these attendants may incur by reason of their youthfulness.

Exemption.—Where leadless glazes or lead glazes of 5 per cent. solubility or under are exclusively used, the age limit shall remain 15 years for dippers' assistants of either sex.

Threading up.

This is a process peculiar to the china furniture branch of the industry, and consists of threading a number of small articles, such as castor runners for tables, chairs, bedsteads and the like, on a wire, with a rubber washer between each to keep them apart. The whole wire, with a dozen or more articles on it, is then dipped in the glaze tub; when withdrawn, the articles are slipped off the wire and placed singly on a board to drain, and the wires and washers are returned to the "threaders up" to be used again.

Prior to 1901 this operation was carried on by the attendants working in the dipping house itself, with the result that several lead cases occurred, some of which were of a very severe type; since 1901 there have been no more, and their cessation is attributed* to the effect of the rule introduced in that year requiring "threading up" to be done in a room separate from any place where dipping or any other scheduled dangerous process is carried on.

Members of the Committee who have taken special note of this process find that it is usual to place the rubber washers in a bucket of water after each dipping; the risk of lead glaze adhering to them when carried into the "threading up" room

* See evidence of Dr. Legge. Questions 540–6.

is by this means greatly reduced, but they are not always absolutely cleaned. The Committee, accordingly, recommend the following rules:—

> Threading up shall not be done except in a room sufficiently separated from any place where a process scheduled as dangerous is carried on.
>
> Rubber or other washers, used to keep the articles apart, shall be thoroughly washed in a colander after each dipping. Wires shall also be washed after each dipping.
>
> *Exemption.*—The above-named rules relating to threading up shall not apply where either leadless glaze or glaze of 5 per cent. solubility or under is exclusively used.

Drying Ware after Dipping.

Immediately after being dipped, the pieces of pottery are placed on boards and allowed to dry.

If, for this purpose, they are not taken out of the dipping house, the same considerations apply as in the case of clay ware which is allowed to part with its moisture in the workroom (see page 52); it is most important that the general ventilation should be such as to carry the moisture away from the workers.

If the ware is put into a separate chamber to dry, the latter should without fail be ventilated directly into the open air in such a way that there shall be no flow of air from it into any adjoining workroom.

In either case, the floors must be kept scrupulously clean, so as to remove all particles of glaze which fall from the ware or boards and might otherwise, when dry, vitiate the air. All the evidence relating to the floors of dipping houses applies equally to the dippers' drying rooms, and the Committee consider that the latter should be made subject to a similar rule.

It was, however, pointed out that there are great differences in the rates at which various classes of ware dry after being dipped; most earthenware bodies are sufficiently porous to absorb the moisture of the glaze rapidly; but china takes a long time to dry, and it is therefore desirable to avoid any movement, which might disturb even a minute quantity of dust in the room, until several hours after the ware has been dipped. The Committee therefore consider it reasonable to continue the exception extended to china dippers' drying rooms by the rules at present in force, and recommend that:—

> Except where leadless glazes or lead glazes of solubility not exceeding 5 per cent. are exclusively used, washable impervious floors, properly sloped towards a drain, shall be provided in all dippers' drying rooms, and shall be thoroughly cleaned daily by an adult male, after work has ceased for the day, with a jet of water and a mop, or other similar implement.
>
> Provided that, in the case of china dippers' drying rooms, this cleaning may be done before work commences in the morning, instead of after work has ceased for the day.
>
> Steam pipes and stillages shall be subject to the same requirements as in the drying of newly made clay ware.

Boards.

The cleanliness of the boards on which newly dipped ware is placed is a matter of the highest importance. Practically all witnesses examined, manufacturers as well as others, were agreed that the lead dust given off in the handling of unclean boards is a grave source of danger, and that such boards should be washed each time after being used, instead of once a week as prescribed by the present rules.

There are, however, certain "nailed" or "pegged" boards, so called because they are fitted with spikes, the cleaning of which with such frequency would, it was pointed out, cause some inconvenience. It appears, however, that they might largely be discarded, and the inconvenience reduced to a minimum. For some classes of china furniture they are, it is true, indispensable, but for ordinary domestic ware for which they are sometimes used they are not essential. This information was supplied by Mr. Burton and Mr. Edwards, two members of the Committee, who specially enquired into the matter, and they recommend the gradual abolition of such boards in favour of ribbed boards in the general earthenware and china branches of the trade.

Many witnesses were examined with a view to ascertaining the best means of cleansing boards, and they were unanimously opposed to any kind of dry process. The application of water they regarded as essential, and many insisted that the water should be clean; attention was further drawn to the possibility of employing an automatic method; a machine constructed for the purpose of washing and scrubbing plain boards has recently been invented by Messrs. Johnson Brothers (Hanley), Limited, who have offered every facility to other manufacturers for its inspection and reproduction, and many witnesses recommended its adoption. The suitability of women and girls for the work was also called in question, and objections raised to their employment by several factory inspectors, certifying surgeons and operatives, on the ground that they were more susceptible than men to lead poisoning.

Both from evidence laid before them, and from their own personal observations, the Committee are convinced that at most factories the cleaning of boards has in the past been very far from satisfactory; the carelessness has been so great that a certain number of boards have not even been cleaned once a week as prescribed by the present rules, and they have frequently been washed in so perfunctory a manner as to leave a thin layer of glaze evenly spread over their surfaces; the rule, moreover, forbidding the transfer of unclean dipping house boards into other parts of the factory has also been repeatedly broken.

All these grave irregularities point to the want of proper supervision in the factories, and the matter is fully dealt with on page 125. But if the regulations are strictly observed, the Committee consider that the following will suffice to prevent the danger due to the careless use of boards not properly cleaned:—

> Every board on which dipped ware has been placed shall, on each occasion after it has been used for one set of articles, and before being used for another, be thoroughly cleaned with clean water by an adult male.
>
> "Nailed" or "pegged" boards shall be cleaned under a strong jet of water; no new boards of this description shall be introduced except where necessary to hold china furniture or other special articles which cannot be carried on ribbed or plain boards.
>
> Boards for use in lead processes shall be clearly marked by painting them red at the ends and for a distance of at least six inches from each end of the board on both sides, so as to distinguish them from other boards which do not come into contact with lead. Boards so marked shall not be used in any department unless they have been thoroughly cleaned, and shall not be used in the clay departments under any circumstances.

Mangles.

In large factories, it is usual for newly dipped ware to be placed, not on single boards, but on the shelves of an appliance known as a mangle. Of such there are two kinds, one horizontal, the other vertical, or "tower"; in both types the shelves are attached to an endless chain which, moving forward extremely slowly, carries the ware through a hot chamber which is heated by a battery of steam pipes.

The chief sources of danger in the use of mangles are:—

1. Excessive heat in the neighbourhood of the mangle.
2. Escape of lead dust into the workroom:
   - (*a*) At the place where newly dipped articles are placed on the shelves, and
   - (*b*) At the opening where the dried articles are gathered from the shelves.

The Committee are of opinion that a rule prohibiting a temperature, in the workshop into which the mangle opens, exceeding 70° Fahrenheit as shown by the wet-bulb, except on such days as the outside wet-bulb shade temperature exceeds 65° Fahrenheit, will adequately remove the risk of injury from excessive heat; they are also convinced that there will be no difficulty in so arranging any mangle as to secure compliance with this temperature limit in its immediate neighbourhood.

To obviate the danger due to lead dust, two conditions must be observed:

(i.) There must be provision for ventilation of such a kind as to maintain a flow of air into the hot chamber from the adjoining workroom.

(ii.) The shelves must be kept thoroughly clean.

(i.) With vertical mangles the necessary ventilation can probably be obtained by providing an adequate opening at the top of the hot chamber, and so making use of the natural air currents set up by the heating pipes; with horizontal mangles, even though the Committee have seen at least one of them which was efficiently ventilated by the provision only of an outlet, it may in many instances be necessary to supplement the action of the air currents by means of an exhaust apparatus.

(ii.) It is at times the custom, according to several witnesses, to clean the shelves of mangles with a dry brush, and such a system is most unsatisfactory. It cannot possibly remove accumulations of glaze without dispersing lead dust into the air, and it is most important, in order to avoid such consequences, that the process should be a wet one.

It was also generally felt that the shelves should be cleaned more frequently. The present rules enjoin that it should be done every week, but the work does not appear to have been carried out with sufficient thoroughness. The Committee have accordingly made careful enquiry as to the practicability of requiring it to be done daily, but to such a course there are two great objections: it would be very difficult to insist on all mangle shelves being emptied at any time other than the end of the week, and the extra handling of the ware might, in certain instances, involve a danger as great as the one intended to be removed. It was therefore regarded as of no avail to alter the existing rule.

The evidence against the employment of women and young persons in cleaning single boards applies equally in respect of mangle shelves, and the rules which the Committee have to recommend with regard to this form of drying apparatus are as follows:—

There must be provision for ventilation of such a kind as to maintain a flow of air into the hot chamber of every mangle from the adjoining workroom.

In the case of vertical or "tower" mangles:—

(*a*) The pipes for heating the mangle shall be fixed above the top of any opening at which workers put in or take off ware; and

(*b*) There shall be a free outlet into the air above, so formed and placed as to ensure an outflow whatever the direction of the wind.

All mangle shelves shall be thoroughly cleaned by a wet process by an adult male every Saturday afternoon after work has ceased for the week.

Ware Cleaning.

There are a large number of common articles which, immediately after they have been dipped, are ready for the glost firing,* by which the glaze is converted into a hard glossy coating on the ware; but, apart from these, it is generally necessary to subject each piece to a trimming process, in order to remove superfluous glaze.

This operation is technically termed "ware cleaning," and the extent and nature of the work is of great variety; on some high-class china articles every inequality in the thickness of the layer of glaze has to be removed, and this involves a light scraping or paring of the greater part of the surface of the ware; again most pieces of pottery require superfluous glaze to be removed from their "feet" or "bases" to avoid the risk of adhering to the bottom of the saggers or other supports on which they rest during the process of glost firing; many special articles, also, must have the glaze removed at certain points, such as the screws to receive pipe connections in the case of sanitary ware, and the small holes in electrical fittings.

The risk run, by those engaged in this process, of contracting lead poisoning is very considerable, and all the witnesses examined laid great stress on the importance of providing them with proper means of protection. The serious incidence of such cases as occur is shown in the following tables:—

* See page 81.

(1) WARE CLEANERS. Whole of United Kingdom (including North Stafford).

Number of persons employed.

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture and Electrical Fittings.	Sanitary.	Totals.	Totals. M. & F.
1901—M.	65	27	—	—	3	—	6	101	545
F.	34	246	45	5	16	78	20	444	
1907—M.	60	40	—	—	2	—	13	115	576
F.	42	226	55	7	14	89	28	461	

Number of cases of lead poisoning.

	China. Cases.	China. Attack rate per 1,000.	Earthenware. Cases	Earthenware. Attack rate per 1,000.	Tiles. Cases.	Tiles. Attack rate per 1,000.	Majolica. Cases.	Majolica. Attack rate per 1,000.	Jet and Rockingham. Cases.	Jet and Rockingham. Attack rate per 1,000.	China Furniture. Cases.	China Furniture. Attack rate per 1,000.	Sanitary. Cases.	Sanitary. Attack rate per 1,000.	Total cases.	Attack rate per 1,000.	Total cases. M.& F.	Attack rate per 1,000.
Under Special Rules from 1894.																		
1899—M.	3	46	—	—	—	—	—	—	—	—	—	—	—	—	3	30	36	66
F.	1	29	28	114	3	67	—	—	—	—	1	13	—	—	33	74		
1900—M.	4	62	2	74	—	—	—	—	—	—	—	—	—	—	6	59	50	92
F.	2	59	30	122	7	156	—	—	—	—	5	64	—	—	44	99		
1901—M.	—	—	—	—	1	7	—	—	—	—	—	—	—	—	1	10	24	44
F.	—	—	16	65	3	67	1		—	—	3	38	—	—	23	52		
Exhaust fans introduced in addition to water troughs.																		
1902—M.	2	31	—	—	—	—	—	—	—	—	—	—	—	—	2	20	21	39
F.	2	59	12	49	3	67	—	—	—	—	2	26	—	—	19	43		
1903—M.	1	15	1	37	1		—	—	—	—	—	—	—	—	3	30	18	33
F.	3	88	9	37	2	44	1		—	—	—	—	—	—	15	34		
Medical examination of men began.																		
1904—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	26	48
F.	1	29	15	61	9	200	—	—	—	—	1	13	—	—	26	59		
1905—M.	1	15	1	37	—	—	—	—	—	—	1		—	—	3	30	17	31
F.	2	59	4	16	6	133	1		—	—	1	13	—	—	14	32		
1906—M.	—	—	—	—	—	—	—	—	—	—	—	—	1	77	1	9	19	33
F.	1	24	13	58	2	36	—	—	—	—	1	11	1	36	18	39		
1907—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	17	30
F.	3	71	12	53	2	36	—	—	—	—	—	—	—	—	17	37		
1908—M.	2	33	—	—	—	—	—	—	—	—	—	—	—	—	2	17	22	38
F.	1	24	13	58	1	18	—	—	—	—	4	45	1	36	20	43		
1909—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13	23
F.	1	24	8	36	2	36	—	—	—	—	1	11	1	36	13	28		

(2) WARE CLEANERS. North Staffordshire District only.

Number of persons employed.

			Totals.
1898	M.	105	563
	F.	458	
1900	M.	81	495
	F.	414	
1904	M.	88	483
	F.	395	
1907	M.	91	487
	F.	396	

Number of cases of lead poisoning.

		Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.
1894 Rules: Overalls, ventilation, sweeping, lavatories, &c., introduced.					
1896	M.	2	19	59	105
	F.	57	124		
1897	M.	—	—	68	121
	F.	68	148		
1898	M.	1	10	59	105
	F.	58	127		
1898 Rules: Monthly medical examination of women and young persons began; and exhaust fans or water troughs introduced as alternatives.					
1899	M.	3	37	32	65
	F.	29	70		
1900	M.	6	74	45	91
	F.	39	94		
1901	M.	1	12	23	46
	F.	22	53		
1901 Rules: Exhaust fans introduced in addition to water troughs.					
1902	M.	2	23	21	43
	F.	19	48		
1903	M.	2	23	15	31
	F.	13	33		
1903 Rules: Monthly medical examination of men began.					
1904	M.	—	—	26	54
	F.	26	66		
1905	M.	3	34	16	33
	F.	13	33		
1906	M.	—	—	18	37
	F.	18	45		
1907	M.	—	—	17	35
	F.	17	43		
1908	M.	2	22	20	41
	F.	18	45		
1909	M.	—	—	13	27
	F.	13	33		

Such being the extent of the danger involved in ware cleaning, there can be no doubt that it is most unsuitable for very young workers. The evidence, moreover, given on this point with regard to dippers' assistants was intended by the respective witnesses to apply equally to ware cleaners, and the Committee consider that in both processes the same age-limits should be enforced.

Ware is cleaned both by dry and moist methods, which must be carefully distinguished from one another. In the dry method, the glaze is first given ample time to part with its moisture, and the excess of it is then scraped off with a knife or some similar tool; witnesses were unanimous in recognising the importance of an efficient exhaust draught, as required by the present rules, for the removal of the dust generated in the process, but the exhaust appliances now in use are almost invariably more or less faulty in construction, and it is absolutely necessary that those which require attention should be remodelled, and that all should be maintained in perfect working order. The means for securing this end will be further dealt with under the heading "Ventilation," and in Mr. Pendock's report* details of the faults to be avoided in constructing the exhaust openings and ducts are fully explained.

Of the moist method of ware cleaning there are two kinds:

(*a*) one, in which the ware is rubbed with wet materials, such as a sponge or a piece of damp flannel;

(*b*) the other, in which it is scraped with a knife or other dry implement before the glaze has had time to dry.

Under the present code of rules, permission has been given to dispense with the provision of a fan or other exhaust draught whenever the ware is cleaned by either of the two moist methods, and many firms have availed themselves of this exemption.†

Of the advantages of the first of these two methods there can be no question; it lends itself to a very large variety of earthenware articles, and entirely obviates the formation of dust. Factory inspectors and manufacturers alike agreed in advocating its adoption wherever possible, and it is therefore most desirable that it should continue to be exempted from any rule requiring the provision of an exhaust draught.

The second method of moist ware cleaning must, however, be viewed in a very different light. As long as the glaze is sufficiently moist at the moment of cleaning, no dust will arise in the process, and the exemption permitted in regard to the use of fans is quite justifiable; but many varieties of ware dry so rapidly that the border-line between wet and dry glaze is quickly reached, and it is often very difficult to determine whether the glaze on a certain article is really moist or not.

Unless, therefore, the degree of moisture contained in the glaze can be clearly defined and established in every case, there must be a risk that some ware will be scraped after the glaze is too dry for this method to be free from dust. There is, however, no rapid means of testing the actual degree of moisture; in consequence the exemption from providing an exhaust draught, to which the process gives a right, acts detrimentally, and to such an extent is this the case that Dr. Legge even went so far as to say that the present rule had, in a sense, broken down.

The Committee have, accordingly, made careful inquiry as to the behaviour of different classes of ware after being dipped, and it appears that, while many will remain moist for several hours, others, such as certain varieties of tiles, will dry within twenty or thirty minutes. They, therefore, consider that fifteen minutes would in all probability be a safe time-limit, and have adopted it in the rule they recommend; but they desire to point out that, if at any future time it be found that fifteen minutes is too long, a shorter period should be substituted.

Another point to be considered is that ware in a dry condition is very frequently cleaned in the dipping house, and several of the operative witnesses advocated the provision of a separate room for all such ware cleaning. There are, however, two aspects to this question: if the exhaust draught provided be inefficient,

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* Appendix XLVIII.

† Number of factories in which all ware cleaning is done moist - - - - - - 176
„ „ part of the „ „ „ - - - - - 105

Total - - - - 281

(See evidence of Dr. Whitelegge. Question 46.)

as is unfortunately largely the case at the present moment, there will no doubt be a risk of dust being dispersed into the air and breathed by dippers and their assistants, as well as by the ware cleaners; but if the fan or other draught provided for the latter workers is adequate, it will not only remove all the dust made by them, but will also assist materially in the maintenance of good general ventilation in the dipping house.

In all probability, the witnesses who advocated a separation of the two processes had present conditions in mind, but in this respect the Committee look forward to a permanent improvement. In any reform it is a *sine quâ non* that all exhaust systems should be perfected, and if this is successfully accomplished, the fans provided for ware cleaning will be an advantage rather than otherwise to the dipping house, if the work is carried on within its walls.

The Committee do not, therefore, see any reason for interference in the present practice, but where it happens that a separate room is used for cleaning the ware, the floors of such a room are open to the same considerations as those set forth in respect of dipping houses and should be made subject to the same regulations.

Water troughs.—In order to catch the glaze which is scraped off in the process of ware cleaning, the Rules of 1898 required a trough or similar receptacle filled with water to be provided, but permitted the provision of an exhaust draught as an alternative. In 1901 the right to regard them as alternatives was cancelled, and whether an exhaust fan were installed or not, the water trough was made compulsory.

With regard to these water troughs, the evidence has disclosed certain irregularities which have been corroborated by the personal observations of members of the Committee. Frequently the glaze has been allowed to collect in the troughs and form a kind of mud, which readily dries on their sides and may be dispersed into the air as dust; again, there are often fitted over the water troughs grids or gratings on which glaze is allowed to collect, to be blown or brushed off later into the room; often, also, it happens that boards of ware are carelessly placed on the troughs, rendering them useless, and that the glaze, as scraped off, consequently falls on the boards or on the floor, in utter disregard of the rule which enacts that it shall fall into the water.

The Committee feel that all these matters require to be dealt with by regulation, and recommend the enforcement of the following precautions in the process of ware cleaning:—

Age limit.—No girl under seventeen and no boy under sixteen shall be employed as a ware cleaner.

Dust.—The process of ware cleaning after the application of the glaze by dipping or other process shall not be carried on without an efficient exhaust draught, except as set forth below.

In the process of ware cleaning of earthenware after the application of glaze by dipping or other process, damp sponges or other damp material shall be provided in addition to the knife or other instrument employed, and shall be used wherever practicable.

Nothing in these regulations shall render it compulsory to provide an exhaust draught for ware cleaning if this process is carried on entirely with the use of wet materials, or if the ware cleaning be done within fifteen minutes from the moment when the glaze is applied; but an efficient exhaust draught shall always be provided and used if any dry materials or implements, such as knives or scrapers, are used after the glaze is dry, or if more than fifteen minutes have elapsed from the moment when the glaze was applied.

In the process of ware cleaning after the application of glaze by dipping or other method, sufficient arrangements shall be made for any glaze scraped off, which is not removed by the fan or other efficient means, to fall into water. All water troughs or other receptacles provided in pursuance of this clause shall be cleaned out and supplied with fresh water as often as necessary, and in no case less often than once a week; and no scrapings of glaze shall be allowed to collect in a dry condition on the sides of the water receptacle. Where grids or gratings are fitted over the water trough or other receptacle above mentioned they shall be kept clean by repeated sponging or wiping with wet material during the time that the process of ware cleaning is being carried on. No boards or other articles

shall be placed, even temporarily, on any such water trough in such a way as to interfere with the efficient use of the trough.

Floors.—Washable impervious floors, properly sloped towards a drain, shall be provided in all ware cleaning rooms, and shall be thoroughly cleaned daily by an adult male, after work has ceased for the day, with a jet of water and a mop or other similar implement.

Lighting.—The same rule shall apply as in dipping houses.

Exemptions.—Under the present rules, any firm using a glaze containing five per cent of soluble lead oxide or less can obtain permission to dispense with a fan, even when doing dry ware cleaning. The Committee recommend that this exemption should be continued.

In all places where leadless glaze or lead glaze of solubility not exceeding five per cent. is exclusively used, the age limit shall remain fifteen, as at present; and the general rule regarding floors (see page 122) shall apply instead of the special provision requiring floors to be sloped and drained.

Glost Placing.

After glazed ware has dried sufficiently to be handled, and has, when necessary, been cleaned, it is taken to the glost placing bench, where it is put into a sagger and eventually carried into an oven* in order to undergo another firing. The sagger† used for this purpose is similar to that in which clay ware is placed for biscuit firing, but the method of supporting the ware is quite different: the slightest contact with another object during firing inevitably marks the glaze, and the ware, in order that there may be as few blemishes as possible on it when finished, is placed on rests‡ provided for the purpose of carrying it with small pointed projections.

The number of glost placers of both sexes in the United Kingdom and in North Staffordshire, and their liability to lead poisoning, will be seen from the following tables.

(1) GLOST PLACERS. Whole of United Kingdom (including North Stafford).

Number of persons employed.

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture, and Electrical Fittings.	Sanitary.	Total.	Totals. M. and F.
1904—M.	219	1,574	219	42	136	28	126	2,344	2,441
F.	—	40	16	—	—	38	3	97	
1907—M.	252	1,593	111	51	113	40	131	2,291	2,411
F.	3	52	30	—	—	32	3	120	

Number of cases of lead poisoning.

	China.		Earthenware.		Tiles.		Majolica.		Jet and Rockingham.		China Furniture, and Electrical Fittings.		Sanitary.		Total.		Totals. M. and F.	
	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Total cases.	Attack rate per 1,000.	Total cases. M.& F.	Attack rate per 1,000.
Under Special Rules from 1894.																		
1899—M.	5	23	49	31	2	9	1	24	—	—	—	—	—	—	57	24	59	24
F.	—	—	2	50	—	—	—	—	—	—	—	—	—	—	2	21		
1900—M.	1	5	27	17	5	23	1	24	—	—	1	36	—	—	35	15	36	15
F.	—	—	—	—	—	—	—	—	—	—	1	26	—	—	1	10		
1901—M.	2	9	19	12	—	—	—	—	1	7	—	—	—	—	22	9	22	9
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1902—M.	1	5	14	9	1	5	—	—	—	—	—	—	1	8	17	7	18	7
F.	—	—	—	—	—	—	—	—	—	—	1	26	—	—	1	10		
1903—M.	—	—	8	5	1	5	1	24	—	—	—	—	—	—	10	4	11	5
F.	—	—	—	—	—	—	—	—	—	—	1	26	—	—	1	10		
Medical examination of men began.																		
1904—M.	—	—	13	8	—	—	—	—	—	—	—	—	—	—	13	6	14	6
F.	—	—	1	25	—	—	—	—	—	—	—	—	—	—	1	10		
1905—M.	2	9	6	4	—	—	—	—	—	—	—	—	—	—	8	3	8	3
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1906—M.	—	—	15	9	—	—	—	—	—	—	—	—	—	—	15	7	16	7
F.	—	—	1	19	—	—	—	—	—	—	—	—	—	—	1	8		
1907—M.	1	4	17	11	2	18	—	—	1	9	—	—	—	—	21	9	22	9
F.	—	—	—	—	1	33	—	—	—	—	—	—	—	—	1	8		
1908—M.	1	4	12	8	1	9	—	—	—	—	—	—	1	8	15	7	16	7
F.	—	—	—	—	—	—	—	—	—	—	1	31	—	—	1	8		
1909—M.	1	4	8	5	—	—	—	—	—	—	—	—	—	—	9	4	9	4
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		

* Called in some parts of the country a glazing kiln.

† In the case of tiles and other special ware small square boxes or other receptacles of suitable shape, and made of fire-clay, are sometimes used instead of saggers.

‡ See page 81.

(2) GLOST PLACERS. North Staffordshire District only.

		Number of persons employed.	Totals
1898	M.	1,805	1,851
	F.	46	
1900	M.	1,821	1,876
	F.	55	
1904	M.	1,872	1,933
	F.	61	
1907	M.	1,853	1,933
	F.	80	

Number of cases of lead poisoning.

		Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.
1894 Rules: Overalls, ventilation, sweeping, lavatories, &c., introduced.					
1896	M.	58	32	59	32
	F.	1	22		
1897	M.	53	29	55	30
	F.	2	43		
1898	M.	48	27	49	26
	F.	1	22		
1898 Rules: Medical examination of women and young persons began.					
1899	M.	53	29	54	29
	F.	1	18		
1900	M.	28	15	28	15
	F.	—	—		
1901	M.	19	10	19	10
	F.	—	—		
1901 Rules: Little change.					
1902	M.	12	6	13	7
	F.	1	16		
1903	M.	9	5	9	5
	F.	—	—		
1903 Rules: Medical examination of men began.					
1904	M.	8	4	8	4
	F.	—	—		
1905	M.	7	4	7	4
	F.	—	—		
1906	M.	8	4	8	4
	F.	—	—		
1907	M.	14	8	15	8
	F.	1	12		
1908	M.	13	7	14	8
	F.	1	12		
1909	M.	8	4	8	4
	F.	—	—		

It will be noted from the above tables that the glost placers are mostly adult men, and that the attack rate from lead poisoning among them is much lower than among dippers, dippers' assistants and ware cleaners.

In a number of factories it is part of the business of glost placers to wipe superfluous glaze from the feet of articles just before arranging them in the saggers, and objection was raised by some of the operatives' representatives to their having such work to do; the Committee do not, however, regard it as involving any greater risk than any other form of ware cleaning, and consider that, subject to careful enforcement of all the rules relating to the process, glost placers should still be allowed to do this when necessary.

The question of the employment of women for glost placing was also brought forward for consideration. Owing to the necessity of lifting the saggers the work is not very suitable for them, and several witnesses pointed out that the arguments* for their exclusion from all lead processes apply with special force to this particular operation. Representative manufacturers, however, considered that such a restriction would be ruinous to the china furniture and electrical fittings branch of the trade, and stated that in this class of work foreign competition is extremely keen, and can only be met by the employment of women, who draw lower wages than men and handle the ware more deftly.

The Committee therefore consider that females should be excluded from glost placing in all branches of the industry except that of china furniture and electrical fittings, and that in this branch they should be treated in the same way as ware cleaners.

* Fully reviewed on page 113.

The ware to be "placed" is conveyed to the benches in the glost placing shop, or glost sagger house as it is termed by some witnesses and is usually carried on boards which, when unclean, very readily become a source of danger; all, therefore, which are used in this process, whether special boards for glost placers only, or the same ones as are used in the dipping house, should be dealt with in the manner set forth on page 73.

The amount of dust generated by the actual operation of glost placing is appreciable. To give an instance in point, Mr. Pendock* describes how in one large shop he found glost placers working in a strong current of air which was blowing such dust straight into their faces. The current was caused by the heat of an adjacent oven which was being fired, and such draughts are by no means uncommon. Whenever possible, therefore, they should be utilised to assist ventilation, and under any circumstances it is of the utmost importance that all air-currents in the workplace should be so arranged as to draw the dust away from the workers. In this respect it is obviously necessary that all windows should be kept in a proper state of repair so as to avoid the possibility of cross draughts being set up through broken panes.

It is also very important that the floors should be maintained in good condition and be kept thoroughly clean. Reference has already been made, in connection with the other departments, to the need of good impervious floors wherever lead is handled, and the advisability of their being sloped towards a drain to facilitate the use of a hose in washing them down. In all glost placing shops the floors should equally be made of impervious material, preferably, as the evidence showed, of blue brick; but, according to several witnesses, there is not the same necessity for a slope, and, to such a formation there are two serious objections: in the first place, a level surface is required to pile up "bungs" of saggers; in the second, if a sagger is wetted, the ware placed in it is apt to be spoilt.

But if the facilities afforded by a slope are not provided, the floors need the more attention, and certain operatives asked that they should be cleaned more often than once a day. Mr. Walmsley thought that there would be no objection to such cleaning being done on each occasion immediately after an oven has been set in.

The Committee accordingly recommend that:—

No woman, young person, or child shall be employed as a glost placer, except in the placing of china furniture or electrical fittings; and no girl under seventeen and no boy under sixteen shall be employed as a glost placer in the placing of china furniture or electrical fittings.

The rules as to cleanliness of boards shall apply as in the dipping house.

All glost placing shops shall be suitably ventilated.†

In all glost placing shops an impervious even floor of brick, flag, or similar hard material shall be provided, and shall be kept in good repair; it shall be thoroughly sprinkled and swept by an adult male whenever the work of setting in an oven or glazing kiln has ceased, and under any circumstances at least once every day.

Exemptions.—In all places where leadless glaze or lead glaze of five per cent. solubility or under is exclusively used, the employment of women should be permitted as at present; the age limit for young persons should also remain at fifteen years.

Sagger-washing.

To prepare saggers for use, a thin glaze, called "sagger-wash," has to be painted over their inner surfaces. This also is part of a glost placer's work, and there was some difference in the opinions expressed concerning it by operative witnesses: one of them advocated a separate room for "sagger-washing"; a second thought the far end of the glost placing shop better than a separate room; while a third considered that saggers should be "washed" in the "hovel," *i.e.*, the space round the oven, and denied that any particular danger was to be apprehended from the sagger-wash, provided it were carefully handled. The Committee therefore do not think that a rule is needed specially to regulate this operation.

In some factories where leadless glazed ware is made it is customary to wash the saggers with a sagger-wash made either from a low solubility glaze, or even from a raw lead glaze. The Committee do not think the risk of lead poisoning

* See Appendix XLVIII. † More fully dealt with later under the heading of General Ventilation, page 117.

involved in this practice is sufficiently great to call for special restrictions; and they feel, moreover, that manufacturers should be encouraged to experiment with leadless glazes fired in saggers specially coated on their inner surfaces with a "wash" or other lining rich in lead; the advantages offered by such a system of working are obvious, as all necessity for the handling of lead compounds by dippers and ware cleaners would be obviated.

The Committee accordingly recommend that such a use of lead should not disqualify a firm from the benefit of exemptions provided for places where leadless glazes are exclusively used; except that the sagger-washer himself must be subject to the same rules as a worker in a scheduled lead process in an earthenware and china works, where there is no restriction in the use of lead. If a lead sagger-wash of low solubility is used, the sagger-washer should be subject to the same provisions as a glost placer in a works where low solubility glaze is exclusively used.

Glost Firing.

The saggers, boxes, or other receptacles are next carried into an oven, and the ware which they hold is fired with the object of fusing the glaze, and thereby giving the surface a glossy appearance and rendering it impermeable; the saggers, etc., are piled up in "bungs" just as in the case of the biscuit oven; the clammings, or sections of temporary brickwork, are built up; the fires lit and the ware fired exactly as before described.

Drawing the Glost Oven.

The question of the temperature in drawing glost ovens is subject to the same considerations as in the case of biscuit ovens, and the Committee recommend that the rules for the one process should also be made to apply to the other.

In drawing glost ovens no dusty operations are involved, but when so employed workers are exposed to the general dust of glost placing shops. To such workers, therefore, the rules recommended for that department should be made equally to apply, but in this respect it was pointed out that as at present worded they are somewhat ambiguous, and, in order to be clear, should contain some specific reference to oven drawing; the Committee accordingly recommend the addition to them of the following clause:—

> The term "glost placing" shall include the carrying of saggers of ware out of the oven after the glost firing.

It should further be mentioned that in view of the high temperature incidental to the operation, the present code relieves workers, while engaged in drawing ovens, from the necessity of wearing overalls and head-coverings, and the Committee recommend the continuance of this exception.

Thimble Picking.

Attention has been called to the necessity during glost firing of placing the ware on rests with pointed projections, and for this purpose the glost placer makes use of a great variety of small clay articles fashioned with points or sharp edges.

Of these, some of the most common forms in use are:—

- "Thimbles," similar in shape to a sewing thimble, but provided with a single horn;
- "Stilts," which in shape consist of three radial arms with upward and downward spikes at the end of each of them.
- "Spurs," *i.e.*, stands like miniature caltrops, with four points, of which three are always down, and the fourth up;
- "Strips or saddles," *i.e.*, long straight pieces with clean sharp edges.

Many of these can be used again after the ware has been taken from the saggers in which the glost firing has taken place; they are therefore collected in baskets and taken to benches at which they are picked over and the broken ones thrown away.

Since 1901 it has been forbidden by the rules to "pick thimbles" save in a room apart from any place where a process scheduled as dangerous is carried on, and this requirement, as indicated in the evidence, has proved of great advantage.

Such a provision should therefore be retained, but it does not remove all risk; the general dust of the glost placing shop in which the saggers are emptied is apt to be vitiated with lead compounds, and there is still grave danger that some of it may be carried to the thimble pickers with the thimbles and stilts, etc., in

the baskets, and be inhaled or swallowed. No danger can arise if the articles to be picked over are carefully transferred from the saggers to the baskets direct, but in many cases they are carelessly thrown about on benches and floor, and swept up afterwards, together with dust and débris and placed in the baskets. The Committee, therefore, recommend that:—

> Thimble picking shall not be done except in a room sufficiently separated from any place where a process scheduled as dangerous is carried on.
>
> All material collected from floors or work benches shall be riddled in an enclosed receptacle before it is taken to the thimble picking room.
>
> For the purpose of these rules the term "thimble picking" shall include the picking over, or sorting, or re-arranging for further use, of thimbles, stilts, spurs, strips, saddles, or any other articles which have been used for the support of articles of pottery during the process of glost firing.

Exemptions.—Of the above rules the first, which is already in existence, has hitherto been relaxed in potteries where leadless glaze only is used, but not in respect of those of low solubility. The Committee do not think this distinction need be retained, and they accordingly propose that: —

> The above rules relating to thimble picking shall not apply to factories where the glazes are exclusively leadless or of solubility not exceeding 5 per cent., unless flow materials* containing lead are used.

Glost Warehouse.

As soon as the ware is taken from the saggers it is carried to the glost warehouse, and any roughness produced at the points where it has been supported in the process of firing is removed, either by "sorting" or "polishing," or by a combination of both methods.

Sorting consists in knocking off the irregularity with a tool resembling a light cold chisel;

Polishing is generally confined to high class pieces of ware, and consists in removing the irregularity more completely by grinding it with a very small emery wheel; this is done either in the glost warehouse or in a separate room adjoining.

There is no evidence of any ill effects arising from either of these two processes; the amount of dust made is quite inappreciable, and the Committee do not, therefore, suggest any special rule to deal with the work of the glost warehouse, other than those relating to ventilation, cleanliness of floors, and the like, which apply to all departments in a pottery.† If plain white pottery is being manufactured, it is at this stage ready to be packed and despatched.

SPECIAL PROCESSES IN THE MANUFACTURE OF COLOURED OR DECORATED POTTERY.

Majolica Ware.

In the manufacture of this class of pottery, coloured glazes or mixtures of glazes and colouring bases are, as stated on page 6, placed on the surface of the biscuit ware at one process.

A glaze rich in lead is generally used, which melts at a low temperature; the necessary pigments are either mixed or fused with it, and the mixture is then applied to the ware either by dipping, painting, mottling, blowing, or other process.

Majolica dipping.—This process does not materially differ from the dipping of other ware, except that in the case of tiles there is no splashing from the shaking of the dipped articles; it is therefore recommended that it be made subject to the same rules.

Majolica Painting.—This process consists in applying the majolica or coloured glazes to the ware with a brush, and is, almost without exception, the work of women and girls. Being a moist one it is not in itself dangerous, but the workers' fingers frequently become smeared with glaze, and the splashes which fall on the benches and surrounding objects, drying rapidly, disseminate noxious dust if they are rubbed or brushed or otherwise disturbed. Under these circumstances the attack rate from lead poisoning among majolica paintresses is somewhat high, as the following tables show:—

* See p. 87. † See pages 115, 122, etc.

(1) MAJOLICA PAINTERS. Whole of United Kingdom (including North Stafford).

Number of persons employed.

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture and Electrical Fittings.	Sanitary.	Total.	Totals. M. and F.
1904—M.	—	7	17	4	1	—	1	30	587
F.	—	40	417	98	1	—	1	557	
1907—M.	—	6	16	4	—	—	2	28	486
F.	3	43	290	118	4	—	—	458	

Number of cases of lead poisoning.

	China Cases.	China Attack rate per 1,000.	Earthenware Cases.	Earthenware Attack rate per 1,000.	Tiles Cases.	Tiles Attack rate per 1,000.	Majolica Cases.	Majolica Attack rate per 1,000.	Jet and Rockingham Cases.	Jet and Rockingham Attack rate per 1,000.	China Furniture Cases.	China Furniture Attack rate per 1,000.	Sanitary Cases.	Sanitary Attack rate per 1,000.	Total cases.	Attack rate per 1,000.	Total cases. M.& F.	Attack rate per 1,000.
Under Special Rules from 1894.																		
1899—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	25	43
F.	—	—	7	175	14	41	4	41	—	—	—	—	—	—	25	45		
1900—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	14
F.	—	—	1	25	6	14	1	10	—	—	—	—	—	—	8	14		
1901—M.	—	—	—	—	1	59	—	—	—	—	—	—	—	—	1	33	6	10
F.	—	—	—	—	4	10	1	10	—	—	—	—	—	—	5	9		
1902—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	5
F.	—	—	—	—	2	5	1	10	—	—	—	—	—	—	3	5		
1903—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	17
F.	—	—	—	—	6	14	4	41	—	—	—	—	—	—	10	18		
1904—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	12
F.	—	—	—	—	6	14	1	10	—	—	—	—	—	—	7	13		
1905—M.	—	—	—	—	1	59	—	—	—	—	—	—	—	—	1	33	8	14
F.	—	—	—	—	7	17	—	—	—	—	—	—	—	—	7	13		
1906—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	14
F.	—	—	—	—	6	21	—	—	—	—	1		—	—	7	15		
1907—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	8
F.	—	—	1	23	2	7	1	8	—	—	—	—	—	—	4	9		
1908—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	16
F.	—	—	2	47	5	17	1	8	—	—	—	—	—	—	8	17		
1909—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	8
F.	—	—	1	23	3	10	—	—	—	—	—	—	—	—	4	9		

(2) MAJOLICA PAINTERS. North Staffordshire District only.

Number of persons employed.

			Totals.
1898	M.	—	295
	F.	295	
1900	M.	—	425
	F.	425	
1904	M.	9	482
	F.	473	
1907	M.	7	394
	F.	387	

Number of cases of lead poisoning.

		Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.
1894 Rules: Overalls, ventilation, sweeping, lavatories, &c., introduced.					
1896	M.	—	—	39	132
	F.	39	132		
1897	M.	—	—	48	163
	F.	48	163		
1898	M.	—	—	31	105
	F.	31	105		
1898 Rules: Monthly medical examination introduced.					
1899	M.	—	—	20	47
	F.	20	47		
1900	M.	—	—	4	9
	F.	4	9		
1901	M.	—	—	3	7
	F.	3	7		
1901 Rules: Little change.					
1902	M.	—	—	3	6
	F.	3	6		
1903	M.	—	—	10	21
	F.	10	21		
1903 Rules: Little change.					
1904	M.	—	—	7	15
	F.	7	15		
1905	M.	—	—	7	15
	F.	7	15		
1906	M.	—	—	7	18
	F.	7	18		
1907	M.	—	—	3	8
	F.	3	8		
1908	M.	—	—	7	18
	F.	7	18		
1909	M.	—	—	4	10
	F.	4	11		

From the first of the above tables, it appears that considerably more than half the majolica paintresses are engaged in tile works, and that the attack rate is generally highest in this branch of the industry. It must, however, be noted that some of the large majolica tile factories are entirely free from lead poisoning cases, and that the bulk of the cases are concentrated at a few works, from which there is a rapid output of the cheaper class of such ware; it is therefore reasonable to conclude that, where large quantities of work have to be done at a cheap rate, there is a tendency to splash the glaze to an excessive degree, and to neglect simple precautions.

To protect the hands of the workers, a number of witnesses were in favour of having a rim so fitted round the brush as to prevent the handle from being smeared with glaze; such a device would undoubtedly be an advantage, but in certain cases, where, for example, great accuracy is required, such a protection might interfere seriously with the work; the Committee, therefore, while recognising that it should be adopted whenever possible, do not think it should be made compulsory.

Other suggestions put before the Committee in evidence dealt with:—

1. The necessity for keeping the hands clean.
2. Precautions for sponging up all splashes of glaze, and generally keeping the work-benches clean.
3. Special provisions for the cleanliness of floors.

The Committee recommend that rules be made as follows:—

A sponge and bowl of clean water, to rinse the fingers, shall be provided on the work bench beside each majolica paintress.

In all majolica painting shops, where there is no adjoining lavatory accommodation* there shall be provided a lavatory sink with a tap, a constant supply of water, and towels.

All splashes of glaze falling on the benches, or surrounding objects, shall be immediately removed with a wet sponge or other wet material.

In majolica painting shops the work-benches and floors shall be made subject to the same rules as those recommended in this respect for potters' shops. They shall not be deemed to be thoroughly cleaned unless all splashes of glaze are completely removed from them.

Mottling is the process of applying a coloured glaze by means of a sponge or similar material to certain parts of the ware only, so as to produce a mottled effect. It was stated in evidence that this is treated as a special form of majolica painting, and the Committee think it is desirable to enact that:—

Mottling, or any similar method of applying glaze, shall only be carried on under the regulations applying to majolica painting.

Glaze Blowing is a process which is carried on at a few of the works engaged in the manufacture of majolica. The coloured glaze is placed in a vessel, usually termed a "glaze kettle," and driven by means of a jet of compressed air through a fine nozzle in the form of spray.

Several witnesses spoke of the dangers which arise unless a thoroughly efficient exhaust draught is provided for the removal of any particles of glaze which tend to become dispersed in the atmosphere.

This method of blowing is not, however, confined to majolica glazes; it is principally used for the application of colours unmixed with glaze, and also, to an increasing extent, in re-glazing portions of articles which have been imperfectly dipped. It will, therefore, be more convenient to deal with all varieties of glaze and colour blowing under a separate heading.†

Subsequent Treatment of Majolica Ware.

Majolica ware, after the application of the coloured glazes, whether by dipping, painting, blowing or other process, is, generally speaking, taken at once to the glost placers, and thereafter follows precisely the same course as ordinary earthenware or china. But occasionally it is first subjected to additional cleaning processes.

* For lavatory accommodation generally, see page 110.

† See page 92.

Panel-cutting, or other method of removing glaze, after its application to ware.—Of these processes panel-cutting affords a typical instance. Parts of the ware, after it has been completely dipped in glaze, are sometimes scraped, with a view subsequently to filling up the spaces thus laid bare, which are called "panels," with some picture or other design; it was stated that this operation often took place after the glaze had had time to dry, and, in one factory at least, no exhaust draught was provided to remove the dust generated.

Further, tiles, after being either painted with or dipped in majolica glazes are usually trimmed along their edges; and sometimes their borders and those of other articles are scraped, if, after majolica glaze has been applied with a brush, it over-runs its proper limit.

The Committee are of opinion that all such processes are simply forms of ware cleaning, and that the case cited, in which this was done dry without the provision of an exhaust draught, was a distinct breach of the present rules. In order that no misunderstanding on such a point may arise in future, they recommend that:—

> All cleaning and scraping, including panel-cutting, after majolica dipping, painting, or blowing,* shall be deemed to be ware cleaning, and shall only be done in compliance with the rules for the latter process.

Under-glaze and On-glaze Decoration.

Besides the use of majolica or coloured glazes, there are two principal methods of decorating pottery.

1. *Under-glaze decoration.*—In this process, the pigments are applied to the biscuit ware before it is dipped in glaze; the great majority of them contain no lead, but in their composition various formulæ are used by different colour makers to produce the same tints, so that it is difficult in any given case to say whether a particular under-glaze colour is or is not harmless.

2. *On-glaze decoration.*—In this case, the ware is first glazed and finished as white ware, and colours, which are usually described as enamels, are subsequently applied to it. In order permanently to affix them, a further firing is necessary, and as lead facilitates the process by acting as a flux, such colours almost invariably contain a considerable proportion of it in their composition.

Preparation of Colours.

The handling of raw lead compounds in the manufacture of colours, so far as it is carried on in potteries, has hitherto been included with the manufacture of frits and glazes in the rule which enacts that "No woman, young person, or child shall be employed in the mixing of unfritted lead compounds in the preparation or manufacture of frits, glazes, or colours." No evidence was tendered to the present Committee regarding the necessity for any change in this rule, so far as it relates to colours, and the Committee, therefore, advocate its retention.

Lawning of colours.—But many colours, when received at the pottery, are found to contain lumps and have to be lawned in a dry state before use. They are placed in a fine gauze sieve, known as a lawn, and rubbed gently through the fabric, either with a stick, a palette knife, or the fingers; all the lumps are thus reduced to a fine and uniform powder, and in the course of the process some dust arises. To remedy this, witnesses were in favour of the provision of an efficient exhaust draught. It was further suggested that the operation should be specified in the schedule of dangerous processes, but this appears to be unnecessary, for dry colours which contain lead, are, as Mr. Redgrave pointed out, already covered by the last clause in the schedule, viz., "Any other process in which materials containing lead are used or handled in the dry state," and the Committee are therefore of opinion that it will be sufficient in recommending a rule for "lawning" of colours, to provide for the removal of dust; it is immaterial whether such colours are for on-glaze or under-glaze decoration, as in either case they may contain lead, but it appears that an exception is necessary to meet the case of enamel painters* who lawn small quantities of colour for their own use. The following wording is accordingly suggested:

> The lawning of dry colours shall be done with an efficient exhaust draught for the removal of dust, except where not more than an ounce at a time is lawned for use in painting.

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* See page 92.

Methods of applying Colours.

For the application of colours to ware, whether under or on the glaze, there are at least six different processes in general use, which are as follows:—

1. Printing.
2. Painting.
3. Ground laying.
4. Colour dusting.
5. Colour blowing.
6. Use of lithographic transfers.

1.—Printing.

The method of printing patterns on to pottery involves the following operations:—

1. *Engraving the design.*—The engraver works from a drawing supplied by the designer, a copy of which he engraves either (*a*) on a flat copper plate, for hand printing, or (*b*) on a cylinder for machine printing.

2. *Mixing the colour.*—The required colours are made up by mixing the necessary pigments with a suitable medium consisting largely of boiled oil.

3. *Printing the pattern on paper*—(*a*) *By hand.*—In the hand process the printer first heats the copper plate on a stove, and with a palette knife covers the whole of the engraved surface with the mixed colour; this he rubs well into the lines of the pattern, subsequently removing any of it which is superfluous by cleaning the plate thoroughly with a pad, known generally as a "boss"; he then places a sheet of thin moist tissue paper over the plate, and presses the two closely together by rolling them several times backwards and forwards between two cylinders; the paper, with the plate to which it is then adhering, is next put for a few moments on the stove again, and as soon as it is completely dry, is stripped off, retaining a reversed impression of the coloured pattern, and leaving the copper plate ready to be used again in the same way.

(*b*) *By machine.*—In large factories the hand process has to a great extent been replaced by a machine consisting of two cylinders, on one of which the pattern is engraved; this is fed with colour, and cleaned automatically, and the paper is printed in strips which are rolled between the cylinders, the upper one of which is heated.

4. *Cutting out the patterns.*—The strips of paper, as soon as printed, are taken by the paper cutter, usually a young girl, who cuts them up into pieces containing the right portions of the design required for each article of ware that is to be decorated.

5. *Placing the pattern on the ware.*—The paper patterns, when cut into proper sizes, are given to the transferrer, nearly always a woman, who places them in position on the ware, rubbing the back of the paper with a suitable tool to make it adhere firmly.

6. *Washing off the paper.*—When a sufficient number of pieces have been treated as above described, the papers are washed off by the transferrer and the paper-cutter in a tub of water, leaving the colour design on the ware.

No evidence was laid before the Committee of any special cases of ill-health arising in any of the above-named stages of the printing process, and Dr. Legge stated that the general rules were sufficient; these require floors to be cleaned daily, but not necessarily by an adult man, and rooms to be properly ventilated.

The need for the latter was, moreover, personally noted by members of the Committee, who, in the course of their visits to potteries, were greatly impressed by the high temperature in which, in some printing shops, the people were working. Such undesirable conditions it is doubtless difficult to avoid altogether, owing to the artificial heat required for the engraving plates and rollers; but the heat, although great, is not generally accompanied by an abnormal amount of moisture, and the Committee do not apprehend any difficulty in applying the temperature rule as set forth on page 53; it is possible, however, that some slight extension of the limit may be requisite for printing shops; the point cannot well be decided without further observations made under varying conditions of weather, but it is one which should receive careful attention.

Special Processes for Ware Printed "Under-glaze."

Hardening-on.—As stated above, the colours used in printing are mixed with oil, and when this has been transferred on to biscuit ware, it tends to interfere with the even spread of the glaze in the subsequent process of dipping. For this reason, it is a common practice first to "harden on" the colour by subjecting the printed ware to a moderate fire; the kilns, known in North Staffordshire as "hardening-on kilns," and elsewhere as "muffles," are fire-brick chambers surrounded by furnace flues. The kilnmen do not come into contact with lead or other dust, and there is no evidence of any special risks attaching to this process.

Solutioning.—In many places, the hardening-on process is dispensed with, and printed ware, immediately before being dipped, is plunged into a dilute solution of some substance which will neutralize the action of the oil in the printing medium. Different solutions are in use, but there is no record of ill-effects arising from any of them.

Looking over biscuit ware.—It frequently occurs that, in printing biscuit ware, specks of colour accidentally appear out of place, and it is of paramount importance that the ware should be looked over, and all such blemishes removed. For this purpose it used to be the custom, prior to 1901, to send the women and girls employed as transferrers and paper-cutters into the dipping house; as a rule, however, they were not regarded as dipping house attendants; they did not, in consequence, undergo any medical examination or observe any of the special precautions for lead workers*, and several lead poisoning cases occurred amongst them. The matter was accordingly mentioned in the proceedings before Lord James of Hereford in 1901, and words were included in Rule 5 of the Award Code, to the effect that "looking over" should not be carried on except in a place sufficiently separated from any scheduled dangerous process.

It appears, however, that in many cases unblemished pottery cannot be produced unless the biscuit ware is looked over at the last moment before dipping, and both manufacturers and inspectors have given evidence before this Committee to the effect that the difficulties of applying such a rule were insuperable. Frequently the assistants who "put up" for the dippers, *i.e.*, hand them the articles, perform the necessary examination and cleaning of each piece while so doing, and it is manifest that such workers incur no additional risk by combining the work of looking over with their ordinary duties.

The above amendment, therefore, affords them no protection, and it was generally agreed that its object would have been achieved if it had been made to apply only to "workers other than scheduled lead workers."

This would no doubt be a logical solution of the difficulty, but the whole addition appears to be superfluous, and the Committee consider it would be preferable to cancel rather than to amend it. In the existing rules any process carried on in a dipping house is clearly scheduled as dangerous, and "looking over," when taking place in a dipping house, necessarily comes within the definition. All so employed are therefore subject to the precautions prescribed for all scheduled lead workers, and any amendment of the words in question in Rule 5 rather than their cancellation would only introduce an element of confusion.†

Use of flow material.—In the application of certain colours to biscuit ware, especially blues, the printed pattern is sometimes softened by causing the colour to run slightly in the course of the glost firing. This is effected by placing in each sagger a material termed "flow." Several different substances are used for this purpose; at least one kind of "flow" is in use, which is free from lead; but the commonest form of it is a mixture of lead chloride or lead oxide with other substances, and most varieties contain sufficient lead to render them extremely dangerous, unless very carefully handled. Often, however, very little care is exercised: the "flow" is generally in the form of powder, which is weighed on a pair of scales kept in some corner of the glost placing shop; no precautions are taken to

* This practice was quite illegal, as the schedule of dangerous processes has always included "any process carried on in the dipping house"; workers, therefore, who were engaged on any operation in the dipping house were *ipso facto* employed in a scheduled dangerous process, and all prescribed precautions should have been observed in regard to them. Their employment was, however, so intermittent that this aspect of the case was seldom recognised.

† For fuller consideration of the schedule of dangerous processes and recommendations in connection with it, see page 97.

prevent it from being blown about the workplace, and it is usually put into the saggers in open cups.

In one or two large works this old method has happily been superseded, the tendency of the "flow" to disperse dust being greatly reduced by mixing the powder with a plastic material. Further to mitigate the danger, it was advocated that separate rooms should be provided for the preparation and weighing out of flow material, and that these operations should be included in the schedule of dangerous processes, in order that the workers engaged in them shall be periodically examined and be made subject to all the other regulations which apply to such scheduled lead workers as millers and mixers of glazes.

The Committee do not feel that they are in a position to suggest that the use of flow in the cake or plastic form should be made compulsory; but they strongly recommend it as safer than the powder. Where the latter is used, it should be most carefully handled, weighed out in the lead-house into standard-sized cups, and delivered to the glost placers with every precaution to prevent dust being scattered from it.

The Committee propose the following rules for all places where a "flow" material containing lead is used:—

A male adult shall be specially appointed to weigh out flow material and deliver it to the glost placers.

The rules recommended for the handling of raw lead compounds in the lead-house shall apply.

The processes of weighing out or preparing flow material shall be included in the schedule of dangerous processes, and shall be carried on in front of an efficient exhaust opening.

Special Processes for On-glaze Printed Ware.

All colours applied to ware after it has been glazed, must be fixed by an additional firing. For this purpose kilns are used similar to those employed for the hardening-on process, and the colours for on-glaze work being described as enamels, they are usually known as enamel kilns. In a few cases, notably when cobalt blue is used, a greater heat is required than such kilns can produce, and the ware after decoration has therefore to be put a second time through the glost oven. In all such colours there is generally a considerable proportion of a lead flux, but there is no record of any lead poisoning having ever occurred among the enamel kilnmen. This firing, therefore, and the operations incidental to it, may be regarded as free from special risk.

2. Painting.

Paints are applied to ware, both under the glaze and upon it, with brushes and similar implements.* But whether the ware is painted in the biscuit or glost state, there is no evidence of any specific illness resulting from the operation. It is true that the on-glaze or enamel colours, as mentioned on page 85, usually contain a considerable amount of lead, but they are mixed with an oily medium, and hence the splashes which may fall on work benches or floors, dry very slowly, and do not give rise to dust.

3. Ground Laying.

This process, which is often locally known as oil and dusting, is in practice confined to on-glaze decoration. A pattern or back-ground is first painted on white glazed ware, whether earthenware or china, with an oily medium, and dry powdered enamel colour is dusted over it with a pad of cotton-wool; the colour adheres wherever the medium has been applied, and any falling elsewhere on the ware is removed by wiping with a piece of clean cotton-wool or other suitable material.

Considerable risk is involved in the use of powdered colours rich in lead, and in 1898 exhaust fans were made compulsory wherever this process was carried on. The result of improved conditions is very clearly shown by the subjoined figures:—

* The term "biscuit or under-glaze painting" is held to include "sponge-work," which is a special method of decoration employed in the manufacture of cheap earthenware, such as that known in the trade as "Persian painted"; in this process a hard sponge is used, which is cut into the shape of a leaf or flower or other simple design, and the colour, mixed with water or oil, dabbed with it on to the biscuit ware.

(1) GROUND LAYERS. Whole of United Kingdom (including North Stafford).

Number of persons employed.

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture, and Electrical Fittings.	Sanitary.	Totals.	Totals. M. and F.
1904—M.	21	25	—	—	1	2	—	49	249
F.	73	112	—	—	13	2	—	200	
1907—M.	37	16	—	1	1	2	1	58	215
F.	71	76	—	2	5	3	—	157	

Number of cases of lead poisoning.

	China. Cases.	China. Attack rate per 1,000.	Earthenware. Cases	Earthenware. Attack rate per 1,000.	Tiles. Cases.	Tiles. Attack rate per 1,000.	Majolica. Cases.	Majolica. Attack rate per 1,000.	Jet and Rockingham. Cases.	Jet and Rockingham. Attack rate per 1,000.	China Furniture, &c. Cases.	China Furniture, &c. Attack rate per 1,000.	Sanitary. Cases.	Sanitary. Attack rate per 1,000.	Total cases.	Attack rate per 1,000.	Total cases. M.& F.	Attack rate per 1,000.
Under Special Rules from 1894.																		
1899—M.	—	—	2	80	—	—	—	—	—	—	—	—	—	—	2	41	10	40
F.	—	—	8	71	—	—	—	—	—	—	—	—	—	—	8	40		
1900—M.	—	—	1	40	—	—	—	—	—	—	—	—	—	—	1	20	7	28
F.	2	27	4	36	—	—	—	—	—	—	—	—	—	—	6	30		
1901—M.	—	—	1	40	—	—	—	—	—	—	—	—	—	—	1	20	1	4
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1902—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	16
F.	—	—	4	36	—	—	—	—	—	—	—	—	—	—	4	20		
1903—M.	—	—	1	40	—	—	—	—	—	—	—	—	—	—	1	20	3	12
F.	—	—	2	18	—	—	—	—	—	—	—	—	—	—	2	10		
1904—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	8
F.	—	—	2	18	—	—	—	—	—	—	—	—	—	—	2	10		
1905—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1906—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	9
F.	—	—	2	26	—	—	—	—	—	—	—	—	—	—	2	13		
1907—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	5
F.	—	—	1	13	—	—	—	—	—	—	—	—	—	—	1	6		
1908—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1909—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		

(2) GROUND LAYERS. North Staffordshire District only.

Number of persons employed.

			Totals.
1898	M.	89	471
	F.	382	
1900	M.	48	335
	F.	287	
1904	M.	41	237
	F.	196	
1907	M.	50	195
	F.	145	

Number of cases of lead poisoning.

		Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.
1894 Rules: Overalls, ventilation, sweeping, lavatories, &c., introduced.					
1896	M.	16	180	50	106
	F.	34	89		
1897	M.	15	169	55	117
	F.	40	105		
1898	M.	10	112	55	117
	F.	45	118		
1898 Rules: Fans introduced; monthly medical examination of women and young persons began.					
1899	M.	2	42	10	30
	F.	8	28		
1900	M.	1	21	7	21
	F.	6	21		
1901	M.	1	21	1	3
	F.	—	—		
1901 Rules: Lord James's Code; changes in detail only.					
1902	M.	—	—	4	17
	F.	4	20		
1903	M.	1	24	3	13
	F.	2	10		
1903 Rules: Medical examination of men began.					
1904	M.	—	—	2	8
	F.	2	10		
1905	M.	—	—	—	—
	F.	—	—		
1906	M.	—	—	2	10
	F.	2	14		
1907	M.	—	—	1	5
	F.	1	7		
1908	M.	—	—	—	—
	F.	—	—		
1909	M.	—	—	—	—
	F.	—	—		

The latter table, for the North Staffordshire District only, shows most clearly the contrast between the conditions existing before and after the introduction of the rules of 1898; the lead poisoning cases in 1896-7-8 averaged 53 per annum, and the annual average has since been under 3. In respect of this reduction it must be admitted that, owing to the increasing use of the blowing process,* the number of ground layers employed in the North Staffordshire potteries has steadily decreased from 471 in 1898 to 195 in 1907; but the attack rate has fallen much more rapidly; the annual average stood at 113 lead poisoning cases per 1,000 workers in 1896-7-8, and was less than 2 per 1,000 in 1907-8-9.

In 1898 it was also ordained that ground layers should undergo a monthly medical examination; the rule came into force simultaneously with the universal introduction of exhaust fans, but it is rather to the latter provision that the rapid decline in cases of lead poisoning is to be attributed; both Dr. Legge and the late District Inspector for Stoke-on-Trent hold this opinion, and their reason for so doing is that the dust generated in the process is one which readily lends itself to removal by means of exhaust appliances.

No evidence was tendered which indicated that further rules were requisite for dealing with this operation, but emphasis was laid on the importance of maintaining a high standard of efficiency† in the exhaust apparatus; members of the Committee have confirmed this by actual observation, and they have also noted carelessness in the handling of the pieces of cotton-wool used by the ground layers: as these wads become charged with dry powdered colour, they must be regarded as potential sources of extremely dangerous dust, and the following additional rules are recommended:—

> Cotton-wool used for ground laying shall be kept in a proper receptacle‡ when not in use. All pieces of waste cotton-wool shall be immediately burnt.
>
> Regulations as to floors and benches shall be the same as in potters' shops; except that the cleaning of floors may be done before work commences for the day, provided that in no case shall any work be carried on in the room within one hour after any such cleaning has ceased.

4. Colour Dusting.

This is a process carried on in connection with printing,§ and is only resorted to in the case of a few colours. When an article of pottery is to be decorated by the colour dusting method, the design, as in the printing process, is impressed by means of engraved plates on tissue paper, but the medium used is an oily one, either coloured or uncoloured. In due course the tissue paper, with the pattern on it, is transferred to the ware; but, instead of being washed off, it is pulled off with a slight jerk; powdered colour is then dusted over the piece of pottery, and adheres to the faint pattern of the oily medium, the superfluous colour being wiped off just as in the operation of ground laying. The process is very clearly indicated in the local name of "plucking and dusting," which is frequently used in North Staffordshire as a synonym.

The statistics of persons employed and lead poisoning cases in this process are as follows:—

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* See page 92.

† See under Ventilation, page 115.

‡ Either the dish containing the colour, or a special receptacle.

§ It should be borne in mind that the term colour dusting is frequently used, more or less colloquially, for much of the work of "oil and dusting," described under ground laying. It is, however, convenient to regard as ground laying all dusting of colours on patterns applied with a brush, reserving the term colour dusting for such work on patterns applied by the printing method.

COLOUR DUSTERS. Whole of United Kingdom (including North Stafford).

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture, and Electrical Fittings.	Sanitary	Total.	Totals. M. and F.
Number of persons employed.									
1904—M.	3	4	2	—	—	—	—	9	159
F.	95	52	3	—	—	—	—	150	
1907—M.	8	5	—	1	—	—	—	14	157
F.	93	45	—	1	4	—	—	143	

Number of cases of lead poisoning.

	China. Cases.	China. Attack rate per 1,000.	Earthenware. Cases.	Earthenware. Attack rate per 1,000.	Tiles. Cases.	Tiles. Attack rate per 1,000.	Majolica. Cases.	Majolica. Attack rate per 1,000.	Jet and Rockingham. Cases.	Jet and Rockingham. Attack rate per 1,000.	China Furniture, etc. Cases.	China Furniture, etc. Attack rate per 1,000.	Sanitary. Cases.	Sanitary. Attack rate per 1,000.	Total cases.	Attack rate per 1,000.	Total cases. M.& F.	Attack rate per 1,000.
Under Special Rules from 1908.																		
1899—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9	57
F.	4	42	5	96	—	—	—	—	—	—	—	—	—	—	9	60		
1900—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	31
F.	5	53	—	—	—	—	—	—	—	—	—	—	—	—	5	33		
1901—M.	1		—	—	—	—	—	—	—	—	—	—	—	—	1		3	19
F.	2	21	—	—	—	—	—	—	—	—	—	—	—	—	2	13		
1902—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	6
F.	—	—	1	19	—	—	—	—	—	—	—	—	—	—	1	7		
1903—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	6
F.	1	11	—	—	—	—	—	—	—	—	—	—	—	—	1	7		
1904—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1905—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	13
F.	1	11	1	19	—	—	—	—	—	—	—	—	—	—	2	13		
1906—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1907—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1908—M.	—	—	1		—	—	—	—	—	—	—	—	—	—	1	71	1	6
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1909—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		

The lead poisoning cases in the above table include one or two which probably owe their origin rather to the process of lithographic transfer making.* It is not possible completely to separate the latter process from colour dusting, as in some factories the same workers are, at different times, engaged in both operations.

It will be seen that the attack rate, as in the case of ground layers, has been very low in recent years; and that, in fact, there has only been one case of lead poisoning since 1905. This is largely due to a reduction in the actual amount of colour dusting done, to which two causes have contributed, viz.:—

1. The growth of the blowing process.†

2. The increased perfection of the printing process. This improvement renders it possible, by means of the simple method of transferring and washing off, to apply many colours for which the operation of dusting was formerly indispensable.

For the rest, all the points brought out in evidence regarding the ground laying process, are equally applicable to colour dusting; and the Committee make the same recommendations, viz.:—

The maintenance of a thoroughly efficient exhaust draught.‡

The provision of a proper receptacle for pieces of cotton-wool.

Regulations as to floors and work benches to be the same as in potters' shops.

Aerograph Processes.

Another method which is widely adopted, of applying coloured liquids to the surface of pottery ware, is by air pressure. Of this there are three kinds:—

1. *Slip Decoration.*—Clays mixed with suitable pigments are ground up in water to a creamy consistency, known technically as "slip," and these are blown

* See page 93.

† See page 92.

‡ See under Ventilation, page 115.

through a nozzle in such a way as to form a band or other pattern on an article of clay ware before it is fired. No lead is used in the material and, the process being a wet one thoroughout, no dust is generated; it has never been regarded as in any way dangerous, and the Committee have no evidence that a special rule is needed to deal with it.

2. *Glaze Blowing.*—On page 84, this process, as used for the application of coloured or majolica glazes, has already been briefly described, and allusion was there made to the increasing use of a blowing method for ordinary white glazes. The latter are usually placed in an aerograph instrument, which is much smaller than a glaze kettle, but is operated on the same principle. Emphasis was laid, in evidence, on the extremely dangerous nature of the spray from any process in which lead glazes are blown, and the consequent importance of efficient exhaust draught for its removal. For such a safeguard provision has already been made in the present rules, and, with the means proposed for securing their adequate observance, there should be no difficulty in giving proper effect to it.

3. *Colour Blowing.*—For this the small aerograph just mentioned is invariably used; the colour is placed in the cup of the instrument and sprayed by the aid of compressed air on to either biscuit or glost ware. An efficient exhaust draught has to be provided under the present rules, and attention to this requirement is to-day more than ever important; in recent years it has been noted that there has been a great increase in the pressure of the air used, which cannot fail to enhance the tendency of the spray to disperse into the atmosphere.

COLOUR AND GLAZE BLOWERS. Whole of United Kingdom (including North Stafford).

Number of persons employed.

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture and Electrical Fittings.	Sanitary.	Totals.	Totals. M. and F.
1904—M.	3	22	3	6	1	1	—	36	251
F.	22	181	2	—	10	—	—	215	
1907—M.	15	28	2	5	1	—	—	51	339
F.	48	221	3	12	4	—	—	288	

Number of cases of lead poisoning.

	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Total cases.	Attack rate per 1,000.	Total cases. M.&F.	Attack rate per 1,000.
1899—M.	—	—	1	45	—	—	—	—	—	—	—	—	—	—	1	28	2	8
F.	—	—	1	6	—	—	—	—	—	—	—	—	—	—	1	5		
1900—M.	—	—	1	45	—	—	—	—	—	—	—	—	—	—	1	28	5	20
F.	—	—	4	22	—	—	—	—	—	—	—	—	—	—	4	19		
1901—M.	—	—	—	—	1		—	—	—	—	—	—	—	—	1	28	2	8
F.	—	—	1	6	—	—	—	—	—	—	—	—	—	—	1	5		
Colour blowing first included in schedule of dangerous processes.																		
1902—M.	—	—	—	—	1		—	—	—	—	—	—	—	—	1	28	2	8
F.	—	—	1	6	—	—	—	—	—	—	—	—	—	—	1	5		
1903—M.	—	—	—	—	1		—	—	1		—	—	—	—	2	56	4	16
F.	—	—	2	11	—	—	—	—	—	—	—	—	—	—	2	9		
1904—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	4
F.	—	—	1	6	—	—	—	—	—	—	—	—	—	—	1	5		
1905—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	8
F.	—	—	2	11	—	—	—	—	—	—	—	—	—	—	2	9		
1906—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	21
F.	1	21	6	27	—	—	—	—	—	—	—	—	—	—	7	24		
1907—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	21
F.	2	42	5	23	—	—	—	—	—	—	—	—	—	—	7	24		
1908—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	15
F.	—	—	5	23	—	—	—	—	—	—	—	—	—	—	5	17		
1909—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		

Various additional precautions were suggested by witnesses in connection with glaze and colour blowing, of which the principal were:—

(*a*) That special attention should be paid to short-sighted operatives on account of the far greater risk incurred by them in having to work with the face close to the piece of ware which they are decorating.

(*b*) That proper provision should be made for cleaning the hoods or air guides in which the work is carried on. The object of these is to concentrate the exhaust draught as far as possible at the point where the spray is most liable to be dispersed into the air; but the more effective they are, the more they become

splashed with colour, which dries on them and is easily rubbed off later as dust. It is, therefore, very desirable that they should be frequently cleaned, and always by a wet process.

(*c*) That attention should be paid to the state of the floors and work benches, and that any colours which fall on either should be speedily and completely removed by a wet process.

(*d*) That to avoid any possibility of workers splashing one another with colour, care should be taken not to overcrowd them. In the opinion of the Committee, any such tendency is rather a question of the efficiency of the exhaust draught, and should be wholly counteracted by a due observance of the requirements* proposed for proper ventilation.

The Committee recommend the following rules to apply specially to the blowing processes:—

No short-sighted person shall be employed to do either glaze or colour blowing, unless wearing suitable glasses. For the purpose of this rule the Certifying Surgeon should enter in the Health Register a certificate, in regard to each glaze or colour blower, stating that he has examined the worker's sight and is satisfied that he or she can be so employed without breach of this regulation.

All hoods in which the blowing of glaze or colour is carried on shall be thoroughly cleaned daily by a wet method.

Floors and work benches shall be subject to the regulations suggested for floors and work benches respectively in potters' shops.

Glaze or colour blowing shall not be done with the mouth.

Decoration on unfired clay ware by means of coloured clay slips shall not be regarded as colour blowing for the purposes of any regulations applying specially to the latter process.

Colour Grinding for Aerographers.—Some evidence was tendered to the Committee concerning the work of assistants in the colour blowing shop, which consists in grinding, for the aerographers, colours mixed with the proper medium; this operation, apart from occasionally placing fresh quantities of colour on the grinding slab, involves no handling of dry materials, but the work is generally done in close proximity to the colour blowers, and the Committee recommend that:—

Colour grinders for aerographers should be treated as colour blowers for the purposes of the regulations regarding medical examination, wearing of overalls, and other precautions which apply to all scheduled lead workers.

Lithographic Transfer Making.

In this process a pattern is first impressed by means of an ordinary lithographic printing machine on tissue paper, backed with ordinary paper; it is then intensified by dusting with enamel colour, which is applied with a pad of cotton-wool; to complete the operation the superfluous colour is removed by being further dusted with coarse flour, known as sharps, or other suitable material, and wiped off with another clean bit of cotton-wool.

Transfers made as above are used for decorating ware, which has been finished in the white glazed state, and are applied in the following manner:—

The tissue paper, which bears the coloured pattern, is first stripped from its backing of ordinary paper; it is then applied to the ware and rubbed with a hard dry brush to make it adhere firmly, and finally washed off, leaving behind it an impression of the coloured design. It will be noted that these processes are closely analogous to those of the ordinary method of applying printed patterns to ware, and the use of lithographic transfers does not appear to involve any special risks.

But in the dusting operations which, as above described, take place in the actual manufacture of lithographic transfers, grave danger of lead poisoning is incurred. While nearly all pottery firms use them to some extent in decorating a portion of their ware, only a very few make their own, and the bulk of those manufactured in England are produced at seven factories which are distinct from potteries, and have been, since January, 1899, under a separate code of Special Rules.†

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* See page 115.

† Special Rules for making Transfers for Earthenware and China, 1899. See Appendix I.

The number of persons employed and the cases of lead poisoning in the seven works in question are as follows:—

	Males.	Females.		Total.
Number employed	132	125	......	257
Lead Cases, 1899	7	4	......	11
„ 1900	7	3	......	10
„ 1901	6	1	......	7
„ 1902	—	2	......	2
„ 1903	2	1	......	3
„ 1904	—	3	......	3
„ 1905	2	3	......	5
„ 1906	—	5	......	5
„ 1907	2	8	......	10
„ 1908	—	2	......	2
„ 1909	1	—	......	1

In addition to periodical medical examinations, wearing of overalls, provision of mess-rooms and lavatories, all of which requirements will be dealt with later under their respective headings, the Rules at present in force at these factories prescribe the provision of efficient exhaust appliances to remove all dust generated in the process of applying dry colour to the sheets of paper. This work is either done by hand or in dusting machines; but in either case medical men and inspectors alike emphasise the paramount importance of efficiently maintaining the fans or other appliances producing the exhaust draught.*

The following points relative to the manufacture of lithographic transfers were also brought out in evidence:—

1. The provision of some safe means of cleaning machines. Inspectors have noted instances where girls have been employed to clean machines with a dry brush in such a manner as unavoidably to inhale considerable quantities of dust, and consider that when the dust is dry a vacuum-cleaner would be more suitable.
2. The provision of floors and work benches capable of being kept properly clean by a moist method.
3. Prevention of carelessness in the handling of pieces of cotton-wool used in the hand dusting processes.

To deal adequately with these points, the Committee recommend rules as follows:—

Machines used in lithographic transfer making shall not be brushed down, but shall be cleaned either:—(*a*) with moist materials, such as oily rags, in such a manner as not to disperse any dust into the air; or (*b*) by means of an exhaust current of air, such as that afforded by a vacuum-cleaner.

The floors and work benches in all lithographic transfer making rooms shall be subject to the regulations suggested for floors and work benches respectively in potters' shops.

Cotton-wool which has been used in lithographic transfer making shall be kept in a proper receptacle when not in use. All pieces of waste cotton-wool shall be immediately burnt.

The above rules should have reference to the manufacture of all lithographic transfers, whether the work be done in a pottery or in a separate factory; and all the recommendations made in this report with regard to age limits, medical examinations, health register, overalls, mess-rooms, lavatories, and other matters affecting the well-being of workers engaged in occupations scheduled as dangerous, are intended to apply to lithographic transfer works in the same way as if they were decorating departments of potteries.

Age Limit in Decorative Processes Named in the Schedule.

It will be remembered that for employment of young persons in some of the most dangerous processes named in the Schedule, such as dipping, ware cleaning, etc., it has been recommended that the present age limit of 15 years should be substantially raised.†

It was considered by various witnesses to be desirable that the same principle should also be applied to the other scheduled processes, which are usually spoken of collectively as decorative, *e.g.*, majolica painting, ground laying, colour dusting, glaze and colour blowing, and lithographic transfer making.

In respect of these operations, factory inspectors and operatives were in substantial agreement in suggesting 16 years as a suitable age, below which no one should be employed, and the Committee recommend a rule to that effect.

* See Ventilation, page 115.

† See dippers, page 68; dippers' assistants, page 71; ware cleaners, page 77; glost placers, page 80.

Gilding.

Patterns are very commonly applied to articles of pottery in gold, and the process takes place after all other decoration has been completed. The gold is used in two distinct forms, the one known as "best" gold, and the other, as "liquid" gold. In either case it is ground up in a suitable medium and applied with a brush, just as in the case of enamel colours. The ware is then subjected to another firing in an enamel kiln or one quite analogous to it. If "best" gold has been used, it emerges from the kiln black or dull grey in appearance, and the bright finish is produced by burnishing with an agate tool, or by scouring with fine sand. If, however, the pattern has been painted on the ware with "liquid" gold, it appears after the kiln firing with its full brightness, and no further process is requisite.

There is nothing to show that special risk attaches to any of the above operations, and the Committee therefore offer no recommendations beyond the general requirements of cleanliness, good ventilation, and reasonable temperature, which are, of course, applicable to every room in every pottery.

Wrapping and Packing.

The finished ware is examined in a warehouse and wrapped in paper, generally by girls and women; it is then handed over to the packers, *i.e.*, men who envelop the goods in straw and pack them in crates or casks or hampers for despatch. None of these processes entail any risk or call for any special comment.

Unclassified Persons in Contact with Lead.

All the processes commonly carried out in an earthenware or china manufactory have now been reviewed, and the number of lead poisoning cases quoted which arise in each process classified as dangerous.

There is, however, yet another class entered separately in the Home Office statistics as "indefinite"; this includes the additional recorded cases which do not fall into any of the above categories, as well as a number, especially in the earlier years, which should doubtless appear as those of dippers, ware cleaners, glost placers, etc., but could not be assigned to their proper tables for want of registered details.

The Committee notice that the number of workers, included under this head, is considerable, and think it probable that useful information regarding certain of the minor lead processes might be acquired by the classification being carried in future to a further stage of subdivision; this would, of course, entail the collection of some additional details of occupation in regard to persons employed in lead processes.

UNCLASSIFIED PERSONS in contact with Lead. Whole of United Kingdom (including North Stafford).

Number of persons employed.

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture, and Electrical Fittings.	Sanitary.	Total.	Totals. M. and F.
1904—M.	16	131	50	3	6	2	6	214	311
F.	8	73	8	—	1	—	7	97	
1907—M.	19	205	73	—	4	11	15	327	459
F.	12	89	5	5	10	7	4	132	

Number of cases of lead poisoning.

	China.		Earthenware.		Tiles.		Majolica.		Jet and Rockingham.		China Furniture, and Electrical Fittings.		Sanitary.		Total.		Totals. M. and F.	
	Cases.	Attack rate per 1,000.	Cases	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Total cases.	Attack rate per 1,000.	Total cases. M.& F.	Attack rate per 1,000.
1899—M.	—	—	5	38	—	—	—	—	—	—	—	—	—	—	5	23	10	32
F.	—	—	5	69	—	—	—	—	—	—	—	—	—	—	5	52		
1900—M.	—	—	2	15	1	20	—	—	—	—	—	—	—	—	3	14	11	35
F.	1		7	96	—	—	—	—	—	—	—	—	—	—	8	82		
1901—M.	—	—	1	8	—	—	—	—	—	—	—	—	—	—	1	5	3	10
F.	—	—	2	27	—	—	—	—	—	—	—	—	—	—	2	21		
Clause to cover these workers added.																		
1902—M.	—	—	1	8	—	—	—	—	—	—	—	—	—	—	1	5	2	6
F.	—	—	—	—	—	—	1		—	—	—	—	—	—	1	10		
1903—M.	—	—	1	8	—	—	—	—	—	—	—	—	—	—	1	5	5	16
F.	2		2	27	—	—	—	—	—	—	—	—	—	—	4	41		
Medical examination of men began.																		
1904—M.	—	—	2	15	—	—	—	—	—	—	—	—	—	—	2	9	4	13
F.	—	—	2	27	—	—	—	—	—	—	—	—	—	—	2	21		
1905—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	6
F.	—	—	2	27	—	—	—	—	—	—	—	—	—	—	2	21		
1906—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1907—M.	—	—	4	20	—	—	—	—	—	—	—	—	—	—	4	12	5	11
F.	1	83	—	—	—	—	—	—	—	—	—	—	—	—	1	8		
1908—M.	—	—	3	15	—	—	—	—	1		—	—	—	—	4	12	5	11
F.	—	—	1	11	—	—	—	—	—	—	—	—	—	—	1	8		
1909—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		

Total of All Lead Poisoning Cases in Potteries.

As a summary of all lead poisoning cases in potteries, the following table shows the totals for:—

(1) The whole of the United Kingdom, distinguishing the china, earthenware, tiles, and other branches of the industry;

(2) The North Staffordshire district alone.

ALL LEAD WORKERS in places under Earthenware and China Special Rules.

(1) Whole of United Kingdom (including North Stafford).

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture and Electrical Fittings.	Sanitary.	Totals.	Totals. M. & F.
Number of persons employed.									
1904—M.	536	2,751	557	100	216	44	190	4,394	6,694
F.	238	1,122	562	110	71	158	39	2,300	
1907—M.	625	2,835	474	96	171	66	237	4,504	6,865
F.	302	1,111	487	170	70	179	42	2,361	

Number of cases of lead poisoning.

	China.		Earthenware.		Tiles.		Majolica.		Jet and Rockingham.		China Furniture and Electrical Fittings.		Sanitary.		Totals.		Totals. M. & F.	
	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Total Cases.	Attack rate per 1,000.	Total Cases. M.& F.	Attack rate per 1,000
1899—M.	13	24	106	39	7	13	2	20	—	—	—	—	—	—	128	29	249	37
F.	8	34	83	74	21	37	4	36	—	—	5	32	—	—	121	53		
1900—M.	11	21	62	23	12	22	3	30	5	23	1	23	1	5	95	22	200	30
F.	10	42	67	60	15	27	2	18	—	—	11	70	—	—	105	46		
1901—M.	7	13	37	13	9	16	—	—	3	14	1	23	—	—	57	13	106	16
F.	2	8	28	25	7	12	2	18	1	14	9	57	—	—	49	21		
Lord James's Code—Rule 3 onwards—came into force.																		
1902—M.	3	6	30	11	6	11	—	—	—	—	—	—	1	5	40	9	87	13
F.	2	8	33	29	5	9	2	18	1	14	4	25	—	—	47	20		
1903—M.	1	2	29	11	8	14	1	10	3	14	—	—	1	5	43	10	97	14
F.	6	25	32	29	9	16	6	55	—	—	1	6	—	—	54	23		
Medical examination of men began.																		
1904—M.	2	4	31	11	6	11	—	—	—	—	—	—	—	—	39	9	106	16
F.	1	4	41	37	19	34	1	9	1	14	4	25	—	—	67	29		
1905—M.	4	8	25	9	4	7	—	—	—	—	2	45	1	5	36	8	84	13
F.	3	13	23	20	14	25	4	36	2	28	2	13	—	—	48	21		
1906—M.	5	8	34	12	7	15	—	—	—	—	—	—	1	4	47	10	107	16
F.	2	7	41	37	10	21	3	18	—	—	3	17	1	24	60	25		
1907—M.	6	10	38	13	4	8	—	—	1	6	—	—	3	13	52	12	103	15
F.	7	23	33	30	6	12	1	6	—	—	3	17	1	24	51	22		
1908—M.	4	6	45	16	3	6	—	—	1	6	1	15	2	8	56	12	117	17
F.	1	3	42	38	8	16	1	6	—	—	8	45	1	24	61	26		
1909—M.	2	3	22	8	4	8	—	—	—	—	—	—	—	—	28	6	58	8
F.	1	3	17	15	7	14	—	—	2	29	2	11	1	24	30	13		

ALL LEAD WORKERS in places under Earthenware and China Rules.
(2) North Staffordshire District only.

Number of persons employed.

			Totals.
1898	M.	3,123	4,703
	F.	1,580	
1900	M.	3,134	4,857
	F.	1,723	
1904	M.	3,250	5,131
	F.	1,881	
1907	M.	3,371	5,299
	F.	1,928	

Number of cases of lead poisoning.

		Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.
1896	M.	152	49	351	75
	F.	199	126		
1897	M.	174	56	386	82
	F.	212	134		
1898	M.	152	49	348	74
	F.	196	124		
1899	M.	110	35	204	42
	F.	94	55		
1900	M.	81	26	165	34
	F.	84	49		
1901	M.	42	13	84	17
	F.	42	24		
1902	M.	26	8	66	13
	F.	40	21		
1903	M.	30	9	75	15
	F.	45	24		
1904	M.	28	9	84	16
	F.	56	30		
1905	M.	31	10	75	15
	F.	44	23		
1906	M.	30	9	85	16
	F.	55	29		
1907	M.	40	12	82	15
	F.	42	22		
1908	M.	41	12	91	17
	F.	50	26		
1909	M.	23	7	49	9
	F.	26	13		

SCHEDULE OF DANGEROUS PROCESSES.

Reference has been constantly made to various recommendations common to all processes scheduled as dangerous, but before proceeding to discuss them, it will be advisable to consider a few verbal amendments which were pointed out by Home Office witnesses as necessary in this Schedule in order to make the description of the processes therein included perfectly full and clear. These amendments the Committee have carefully considered, and recommend that in the new code of regulations the Schedule should be worded as follows:—

SCHEDULE.

Part I.—Lead Processes.

Making or mixing of frits, glazes, or colours containing lead.

Dipping or other process carried on in the dipping house.

Application of majolica, or other glaze, by blowing, painting, or other process.

Drying after the application of glaze by dipping, blowing, painting, or other process.

Ware cleaning after the application of glaze by dipping, blowing, painting, or other process.

Glost placing.

Preparation and weighing out of "flow" material.

Ground laying, including the wiping off of colour after this process.

Colour dusting } whether on-glaze or under-glaze, including the wiping
Colour blowing } off of colour after each of these processes.

Colour grinding for colour-blowers.

Lithographic transfer making.

Any other process in which materials containing lead are used or handled in the dry state, or in the form of spray, or in suspension in liquid other than oil or similar medium; provided that the stopping of biscuit ware with a material containing lead shall not be deemed to be a process included in this Schedule.

Part II.—Other Processes.

Scouring of biscuit ware which has been fired in powdered flint.

Emptying of biscuit ware which has been fired in powdered flint, from the baskets or other receptacles in which it has been conveyed to the biscuit warehouse or scouring shop.

RECOMMENDATIONS APPLICABLE TO EMPLOYMENT IN SCHEDULED PROCESSES GENERALLY.

Medical Examinations.

Periodical examination of lead workers.—Every scheduled lead worker is required by the present rules to be examined once in each calendar month by a Certifying Surgeon, and the Certifying Surgeon is empowered to suspend any such worker from employment.

Both these provisions should be retained; but, with regard to the periodical medical examinations, several points require consideration. One difficulty presented is the cost. If workers wilfully absent themselves from any periodical visit which, after due notification, has been made at a reasonable time by the Certifying Surgeon, it is only fair that they should bear the expense of an independent examination; but, otherwise, it was strongly urged in evidence that no charge should be made to them. With this view, all classes of witnesses, including employers, operatives and inspectors, were in accord.

To the casual worker, that is, the man who is engaged for only an odd day's work at a time, the present system was described as being a genuine hardship. A number of pottery operatives, especially glost placers, belong to this class; they stand at certain times at well-recognised places, such as the market-place in Burslem, and near the railway bridge in Longton, waiting to be hired for a temporary job, but none the less, their speciality being a process which is scheduled as dangerous, they are required by the rules to be medically examined once in each calendar month. In 1903, when such examination of male adults was made compulsory, a portable register, to be signed each month by the Certifying Surgeon, was given to each casual worker to carry about him, and by this certificate he was made legally eligible for employment in glost placing or other scheduled occupation at any factory within the Surgeon's district. If the man is fortunate enough to be working at a factory at a time when the Surgeon pays his periodical visit to it, he can present himself for examination, and the firm pays a fee, calculated at the rate of 6d. per head* if the number is five or upwards, for the whole number examined. If, however, he does not happen to be employed at any factory on what is colloquially termed "the Doctor's day," he must, before the end of the month, attend at the surgery to be examined, and for this he is required to pay one shilling. The hardship of such a regulation is the more striking when it is borne in mind that most of these men are at least semi-unemployed, and the shilling fee is therefore a more serious item to them than it would be to operatives in regular work.

After considering at great length various suggestions to overcome the difficulty, the Committee find themselves unable to recommend any practicable regulation which will ensure that, in every case, the whole of the cost of these special examinations, both as regards the Surgeon's fee and the travelling expenses of the worker to and from the surgery, should be paid by the party in fault. The number, however, of cases in which this difficulty arises is fortunately not great, and the Committee moreover, understand that, provided the workers are themselves considered in all cases to be responsible for the payment of any travelling expenses which they may incur, the manufacturers are willing to pay the fee of the Certifying Surgeon, whether the workers may or may not have been to blame in missing the periodical examination.

* This is subject to the condition that no fee for an examination involving a visit to a factory can be less than 2s. 6d., for which sum any number of workers not exceeding five may be presented to the Certifying Surgeon.

In the case of casual workers examined at the Certifying Surgeon's surgery, the Committee suggest that a fee of one shilling should be paid as at present by the person examined at the time that the certificate is entered in the portable register by the Certifying Surgeon, and that the shilling be refunded to the worker by the Occupier who first employs him after the examination. The Occupier, on refunding the fee to the worker, should make an entry to that effect in the portable register. If any casual worker happens to be employed at a factory on the day of the Certifying Surgeon's visit there, he shall be entitled to present himself for examination, as at present. The Committee consider that this arrangement will reduce to the smallest possible dimensions any hardship that may exist, and therefore recommend a regulation to this effect.

Several objections were also raised to the present system of requiring Surgeons to obtain their fees direct from the employers. It was suggested that a scheme might instead be adopted whereby every employer of scheduled workers should be required to procure a licence or certificate for a sum proportionate to the number employed by him, and sufficient to provide a fund from which to remunerate the Certifying Surgeons for all medical examinations. Several manufacturers were questioned concerning this scheme, and none of them had any objections to make to it. Whether or not there are administrative difficulties involved, the Committee are not in a position to judge.

Reference was also made in evidence to the need of having the time of the Surgeon's monthly visit to the works clearly specified, and cases were cited of hardship inflicted on operatives by their having to attend for examination at a factory on a day when there was no work for them to do there. It therefore appears that there is occasionally some ground for the suggestion. The arrangements made by Surgeons as to the times of their visit are, as a rule, fairly complete, but the Committee think it would be desirable for the Secretary of State, as far as practicable, to issue definite instructions for their regulation.

A further very important question in connection with the periodical examinations is that of securing adequate privacy; no details were given in evidence of specific occasions on which this obvious necessity had been disregarded, but sufficient references were made to the want of it, as a matter of rumour, to render it desirable that there should be a rule prescribing the provision of a private room for the Surgeon's use when at the factory—a custom which in many factories already appears to obtain. Such a regulation should, however, be carefully framed, so as to avoid excluding an additional medical man, if the Certifying Surgeon requires him to be present for the purpose of consultation; it should also admit, under certain circumstances, of the presence of a worker's mother or other relative, which might be desirable when a young girl is being examined for employment in a scheduled process.

It was alleged by several witnesses that in order properly to conduct these periodical examinations, Certifying Surgeons ought to be required to devote their entire time to them, but on the other hand, weighty arguments were advanced by H.M. Chief Inspector of Factories and by Dr. Legge and others, against debarring the Certifying Surgeons from private or hospital practice.

The Committee are, however, greatly impressed with the difficulties and responsibilities which devolve on the Surgeon in making the periodical examination. Apart from the answers as to subjective symptoms (which may or may not be given accurately) and the condition of tongue and pulse, he has three main signs to guide him: the presence of a blue line on the gums, progressive anæmia and a tendency to weakness of the wrists, which are danger signals in the case of lead workers. There are other aids to diagnosis which cannot be carried out as a matter of routine, but which the Certifying Surgeon avails himself of in particular cases, such as the ophthalmoscopic examination of the fundus of the eye, the electrical reaction of certain muscles, the analysis of the urine, the determination by special microscopical and other methods of the constituent elements of the blood. Some of these tests no doubt require a laboratory equipment* and their value as a means of diagnosis depends to a large extent on the expertness acquired in a special branch of pathology, but the Committee are strongly of opinion that every facility should be given to the Certifying Surgeon in applying them in individual cases.

* This is now available at many general hospitals.

On these points the Committee are unable to lay down any definite rule. It appears, however, that at Bradford, where the risk of Anthrax gives rise to somewhat similar difficulties, a specialist has been appointed whose stipend is paid by private contributions of manufacturers and others, including one made by the Home Office with the consent of the Treasury.

For the smooth working of Section 8 of the Workmen's Compensation Act some such arrangement seems to be essential, and, indeed, to have been contemplated. In connection therewith, it is provided* that in cases involving special difficulty, the Medical Referee may apply for special expert assistance, which may be granted by the Secretary of State, if he thinks fit, on such terms as to remuneration or otherwise as he may, with the sanction of the Treasury, determine. This applies only to Medical Referees, and the Committee are of opinion that in pottery districts it is very desirable that opportunities should be afforded to Certifying Surgeons of obtaining, in difficult cases, the assistance of various specialists who should be approved by and receive their remuneration from the Home Office. The specialist to be consulted in any particular case should be mutually agreed upon by the Certifying Surgeon and the operative, or the latter's medical man if the case is already under treatment.

Preliminary examination of lead workers.—It was maintained by a number of witnesses, representing the operatives, that no worker should be eligible for employment in a lead process unless he had first been medically examined; but, as against this, it was admitted by medical experts that it was, broadly speaking, impossible to judge in advance whether or not any person would actually prove susceptible to lead poisoning. A preliminary examination would probably result in the exclusion of all workers who were found to be below the average in general health and strength, yet it has been proved that many such can be employed in dangerous processes without developing any illness; on the other hand workers, who would certainly pass the preliminary tests, may exhibit a marked susceptibility to poisoning after a brief exposure to dust containing lead. In any case, with a visit of the surgeon to each works once in each calendar month, no worker could possibly escape examination for more than seven or eight weeks; in the ordinary course, he would not escape for more than a month, and the average period would only be about a fortnight.

Under these circumstances, the Committee do not see that anything would be gained by a preliminary examination, but consider that every worker when employed for the first time in a process included in the Schedule should, on the occasion of his first appearance before a Certifying Surgeon be examined with particular care, and that such examination should include a test of the eyes, so that short-sighted workers, unless provided with suitable spectacles or other eye glasses, should not be engaged on work which they would have to do dangerously near the face. The Committee understand that a recommendation to this effect was included in the Standing Instructions of the Home Office to Certifying Surgeons, drawn up in 1902.

Examination of Workers who handle only ware dipped in glazes of solubility not exceeding 5 per cent.—Workers employed in potteries where low solubility glazes are exclusively used are, under the present rules, in an anomalous position; the women and young persons are every month examined by the Certifying Surgeon, but adult men, in accordance with the award of Lord James of Hereford, have no medical examination to undergo. No evidence was submitted to the Committee to show that this immunity from examination was attended by any ill results, and it is significant that among the women and young persons there has not been in such potteries, during the last few years, even a single case of suspension from work in lead processes.

It is true that, as mentioned on page 28, the number of workers in question is but small, viz., about 260, and that the data are consequently somewhat limited. Presumably, however, the risk involved, if any, is very slight, and the Committee feel justified in recommending that, pending any record of ill-effects from handling ware dipped in glazes of solubility not exceeding 5 per cent., periodical medical examinations shall be dispensed with in the case of all workers solely engaged in the dipping, ware cleaning or glost placing of such articles.

* See Regulation 18 (iii.) of the "Regulations made by the Secretary of State under Section 8 of the Workmen's Compensation Act, as to the duties and fees of Certifying Surgeons and Medical Referees."

This concession, they hope, will prove to be an additional and powerful inducement to manufacturers to confine themselves to glazes of this type whenever possible.

Examination of workers in processes not involving contact with lead.—These workers are not in the same favourable position as lead workers under the existing Workmen's Compensation Act, and the question, therefore, of their examination requires very careful consideration from this point of view; it is, accordingly, fully dealt with under the heading "Compensation" on page 102.

The rules relating to periodical medical examinations which the Committee recommend are as follows:—

All workers in scheduled lead processes shall be examined once in each calendar month by the Certifying Surgeon for the district; and all workers in scheduled processes other than those involving contact with lead shall be examined once in every twelve months by the Certifying Surgeon for the district.

The Certifying Surgeon shall have power of suspension as regards any person employed in a process named in the Schedule; and no person, after suspension, under these, or any other regulations or special rules,* shall be employed in any process named in the Schedule, without written sanction by the Surgeon. Certificates of suspension or of permission to resume work shall be entered in the Health Register either personally by the Surgeon, or by means of written notice sent by him to the employer, who shall attach it forthwith to the Health Register, such notice to be replaced by a personal entry in the Health Register by the Certifying Surgeon at his next visit to the factory.

All medical examinations made in pursuance of these Regulations shall be free of cost to the workers, whether they be in regular or casual employment. Provided that casual workers examined at the Certifying Surgeon's surgery shall pay a fee of one shilling for each certificate entered in the portable register; this fee shall be refunded by the occupier who first employs the worker after such examination, and the occupier shall record in the portable register the fact that the fee has been refunded.

A notice shall be affixed, in a prominent place in the factory, showing clearly the time appointed for the Surgeon's periodical visit; an amending notice shall be affixed forthwith if it is found necessary to alter the date or hour; and, wherever possible, not less than three days' notice of a change of date shall be given.

All medical examinations shall be conducted in a private room. Besides the worker, no one shall be present with the Certifying Surgeon except such other medical man or relative of the worker as the said Surgeon may decide to admit; provided that, if the mother of a worker desires to attend at that worker's medical examination, she shall be allowed to be present, provided she has sent to the Certifying Surgeon a request in writing to that effect.

Health Register.

The Health Register, as already explained on page 61, is a book, kept on the premises of each factory, in which the Surgeon enters the results of his periodical examination of the workers. It naturally, as time proceeds, constitutes an epitome of the general health of all those whose names appear in it, and evidence was laid before the Committee requesting, on behalf of operatives, that it should be regarded strictly as a private document, only open to the inspection of the Certifying Surgeon and H.M. Inspectors of Factories. The reason assigned for this suggestion was a supposition that some unscrupulous employers have occasionally abused the information obtained from it, and, solely on account of a decline in general health, have dismissed certain workers in the hope of saving the expense of compensation and avoiding the discredit attaching to cases of lead poisoning. The

* This clause appears necessary in order to provide against the possibility of a worker suspended from employment in a white lead, or similar factory, seeking lead-work in a pottery; but this is a matter which can perhaps be dealt with administratively better than by regulation.

former consideration, however, can hardly carry much weight, as nearly all employers are insured against claims to which they are liable in cases of poisoning; the manufacturers, moreover, who were examined on the point, could hardly bring themselves to believe in the possibility of such being the motives which actuate any one of their number, and strongly protested against the suggestion to deprive them of the right to consult the book containing the Surgeon's remarks; cases were also cited of manufacturers whose habit it is not to discharge any workers who appear, from entries in the Health Register, to be below their normal condition, but temporarily to find them some healthier occupation, and this practice is clearly worthy of every encouragement. It may be, therefore, that the operatives' fears are groundless, and in any case the Committee consider that the objections to making the Health Register a private document and the administrative difficulties which any such attempt would involve, must both be regarded as valid; but clearly if the employers have free access to it, the workers should have the same facilities, and the Committee accordingly recommend the following rule:—

> A Register, in the form prescribed by the Secretary of State for use in Earthenware and China factories, shall be kept, and in it the Certifying Surgeon shall enter the dates and results of his visits, the number of persons examined in pursuance of these Regulations, and particulars of any directions given by him. This register shall contain a correct list of all persons employed in the processes included in the Schedule.
>
> The register shall be open to the inspection of any worker whose name is required to be entered therein so far as the entries relate to that worker; and all such entries as indicate the general health of the worker, shall be so expressed as to be readily understood both by occupiers and persons employed.

The Committee suggest, also, that it would be well to ask H.M. Medical Inspectors of Factories to draw up, for the use of Certifying Surgeons, a code of symbols denoting various conditions of general health which would be readily intelligible to all persons who may consult the Health Register; the Surgeons should also be instructed to inform each worker at the time of the examination, what mark is being entered in the book against his name.

Compensation.

In view of the passing of the Workmen's Compensation Act, 1906, the retention of Schedule B of Lord James's Award, 1903—under which the pottery lead worker suffering from plumbism has an alternative method of procedure—appears to be superfluous. The latter was the pioneer scheme of compensation for industrial diseases, and worked smoothly, that is to say, with a minimum of legal disputes on technical points; but the provisions of the two schemes are largely identical, and, in several important respects, the new Act is more favourable to the workers: the lump sum, for example, payable in the case of the death of a woman or young person is much greater, and in non-fatal cases exceeding a fortnight in duration, the weekly payments accrue from the date of disablement instead of from the end of the first fortnight of incapacity; it was also clearly shown in evidence* that under Schedule B., the dependants of a worker whose death occurred too suddenly to admit of his being formally examined or suspended by the Certifying Surgeon, possessed no legal claim.

On the other hand, it may be contended that the words in the Schedule defining the period during which compensation is payable, viz.:—"while he is totally or partially prevented from earning a living by reason of suspension," admit of a wider interpretation than the corresponding expression, viz.:—"during the incapacity," used in the Act; if the first definition be taken to mean that a worker who has lost his situation owing to suspension from employment in a lead process, can, although completely recovered, continue to claim compensation until he is again able to obtain work, it would certainly appear to be the more favourable offer of the two; but there is no evidence to show that any worker has availed himself of this point of apparent difference, and the advantages, therefore, of the Schedule appear to be too problematical to be worth consideration.

* See especially the evidence of Sir Henry H. S. Cunynghame, K.C.B., Questions 7748 to 8020.

The cases of alleged hardship in connection with compensation for lead poisoning, of which a number were cited by witnesses, all appeared to be due to one or other of three causes:—

(*a*) The delay of payments;

(*b*) The payment of unjustifiably small amounts;

(*c*) The non-payment of compensation for precautionary suspension.

(*a*) *Delay of payments.*—The Committee desire to point out that, in their opinion, manufacturers should see that all payments of compensation are made on the day on which they become due, and that they are sent to the worker.

(*b*) *Payment of unjustifiably small amounts.*—Repeated references were made, in evidence, to the evils resulting from the practice of terminating claims to weekly compensation by the payment of a lump sum. While this may be open to grave objections the law allows such bargains to be made by adults and, under certain restrictions, by young persons as well; the Committee, therefore, cannot offer recommendations on this point, but they desire to suggest that the possibility of an employer or insurance company using undue pressure to induce a worker to accept an insufficient lump sum in lieu of all claims to weekly compensation, should be more fully guarded against in any future legislation on the subject.

(*c*) *Non-payment of compensation for precautionary suspension.*—A Certifying Surgeon, when he examines a lead worker, usually takes one of three courses:—

1. He may pass the worker as fit for his employment, in which case he places in the Health Register a mark showing the general state of the worker's health, such as "Good" or "Fair."

2. He may suspend from employment on the ground that continued work in a lead process would involve serious risk of lead poisoning.

3. He may suspend from employment on the ground that the worker is suffering from plumbism, which means that he is reported to H.M. Chief Inspector of Factories as a lead poisoning case, and can make a claim for compensation.

Cases which come under the second of the above categories are commonly known as precautionary suspensions, and Sir Henry Cunynghame, the Legal Assistant Under Secretary of State in the Home Office, pointed out in evidence that in such cases doubts frequently arise as to whether a worker so suspended is entitled to compensation, for under Schedule B, where the incapacity is not in any respect due to the employment there would be no compensation, but if it could be said that to any extent, however small, the incapacity was due to the occupation, then the surgeon could certify for compensation. Such cases, therefore, often present great difficulty, and it is stated that payment has been made in many doubtful cases by the Potters' Mutual Insurance Company.

Similar considerations apply in the case of the Workmen's Compensation Act, 1906, though the wording is somewhat different; under Schedule B it was provided that a person, before being entitled to compensation, must be "suffering from plumbism," whereas the corresponding certificate under the Workmen's Compensation Act must certify that the person has "contracted the disease."

If it appears that a worker will incur risk from continued work in a lead process, it often happens that he is transferred to an occupation involving no exposure to lead, and much evidence was tendered showing the advantages of such a practice; Certifying Surgeons stated that cases frequently occur where this course is better for the sufferer than entire stoppage of work, and they added that they found employers very willing to co-operate on these lines; but the testimony of manufacturers, who also strongly advocate such change of employment, shows that in many works it might not be practicable, and it would be difficult, therefore, to lay down a hard and fast rule to this effect. The Committee, however, consider that steps should be taken to secure for all persons who are suspended as a precautionary measure, some reasonable compensation; if the Certifying Surgeon certifies that the worker whilst so suspended from employment in any lead process, is nevertheless fit for light work in an occupa-

tion not involving exposure to lead, the employer should in all such cases endeavour to provide him with suitable light work; failing this, or in the event of the earnings at such light work being less than he was previously receiving, the person suspended should be entitled to compensation on the usual scale, at any rate for a limited period, such period to be at the discretion of the Certifying Surgeon, but in no case to exceed three months; this provision should not apply to any worker who has been employed in a scheduled lead process for a period not exceeding one month.

Among the considerations which the Certifying Surgeon has to take into account in deciding whether or not to suspend as a precautionary measure are careless personal habits, such as want of attention to cleanliness of hands and teeth or of clothing, or biting of nails, or taking food in prohibited places, or neglect of other precautions prescribed; such suspensions must, of course, be looked upon solely from the point of view of protection of the worker, and not in any sense as a means of punishment; but workers so suspended should obviously be debarred from benefits under the special compensation arrangements advocated in the preceding paragraph.

Other provisions relating to suspensions.—Manufacturers should note further that they have no right to give notice of dismissal to a worker during a period in which he or she is suspended from employment under a certificate given by the Certifying Surgeon. Operatives are, moreover, not called upon to attend at a surgery or other place for examination during the continuance of their suspension, if they are not in a fit state of health to do so; the occupier can call upon them to submit to examination at the hands of a medical man whom he selects, but the doctor can be required to make his examination at the place where the patient is living at the time.

It is also provided, under Section 8 (4) of the Workmen's Compensation Act, 1906, that the Certifying Surgeon has the power to enter on his certificate as the date of disablement, a date anterior to that on which he first sees the patient; when he is satisfied that the patient has been absent from work by reason of his sufferings from an illness industrially contracted, it is the Surgeon's duty to enter as the date of disablement on the certificate, the day on which the patient's necessary absence from work commenced. The Committee think it very desirable that instructions should be issued to employers calling their attention to these and any other similar matters of detail that may arise.

Penal Compensation under the Factory and Workshop Act, 1901.

Section 136 of the Factory Act of 1901 enacts that—

"If any person is killed or dies, or suffers any bodily injury or injury "to health, in consequence of the occupier of a factory or workshop having "neglected to observe any provision of this Act, or any regulation made in "pursuance of this Act, the occupier of the factory or workshop shall be "liable to a fine not exceeding one hundred pounds, and, in the case of a "second or subsequent conviction in relation to a factory within two years "from the last conviction for the same offence, not less than one pound for "each offence; and the whole or any part of the fine may be applied for the "benefit of the injured person or his family or otherwise, as the Secretary of "State determines."

No evidence was forthcoming to show that this section has been put in operation in cases of lead poisoning in potteries, but the Committee are of opinion that there is urgent need for the imposition of an adequate penalty when a lead poisoning case can be connected with a proved breach of the rules.

Other suggestions re Compensation.

Workers in processes not involving contact with lead.—As already briefly pointed out, the Committee have found themselves in a difficult position with regard to the medical examination of workers especially liable to lung diseases.

Such examinations would need to be followed by suspension of employment in the case of those whose lungs were found to be seriously affected, and such a rule

witnesses agreed could not in fairness be imposed on the workers without giving them compensation; a worker may completely recover from a threatened attack of lead poisoning by being moved from his dangerous environment, and may return to his work an absolutely sound man; but if his lungs have once been sufficiently affected to justify suspension, it is very doubtful whether he could ever return with safety to his hazardous employment. With medical inspection it would no doubt usually be possible to detect the trouble in time to allow of recovery, when the workers could undertake work of another description; but, as lung diseases are generally of very slow growth, most suspensions would occur after the worker had passed middle age, and would, therefore, be considerably handicapped in seeking employment in a new occupation. The prospect for such a man, if he were not compensated, would be a miserable life for some ten or fifteen years, and he might well prefer to die in harness after five years, with the better chance of providing for his family.

In the case of china biscuit placers, no such examination has hitherto been attempted, but it is strongly advocated; the names of the china biscuit emptiers have been recorded in the Health Register for a number of years past, but these workers have only been medically examined in isolated cases where the employers have adopted this course voluntarily; while the china scourers have been examined regularly by the Certifying Surgeons since 1898.

The total numbers employed in these three branches of pottery work are extremely small as compared with the total number of workers who suffer more or less from occupational lung trouble; the high death rate from phthisis and other respiratory diseases* calculated on the estimated number, 23,000, employed in processes involving exposure to dust other than lead dust, cannot possibly be brought about merely by the very excessive risk run by the few hundred china biscuit placers, emptiers and scourers; it is therefore obvious that there must be other and larger classes which have contributed abnormally to the lung disease death rate, and a periodical medical examination of all these would be most valuable. But, even if such an examination were made only once a year, the numbers involved would render it expensive, and the manufacturers object to undertaking such a serious additional burden.

A still greater difficulty arises from the fact that lung illnesses acquired in consequence of employment are not scheduled diseases under the Workmen's Compensation Act. This aspect of the matter has been considered already by the Industrial Diseases Committee, which reported in 1907, but they could not recommend schedules of industrial lung diseases because of the extreme difficulty of distinguishing such diseases when of industrial origin, from similar ailments arising from natural causes. Notwithstanding this, the present Committee do not feel that the matter can be allowed to rest as it is, and they therefore urge that a medical investigation should be made on the following lines.

In the first place steps should be taken to determine the proportionate risk of injury among different classes of workers, and with this object in view, considering on the one hand the numbers employed, and on the other the high incidence, as gauged by the death returns, of lung affection among them, a satisfactory classification might reasonably be expected by the examination of workers between the ages of 25 and 65; as the most practical course, therefore, to pursue, it would seem to be advisable that medical men with clinical experience in lung diseases should be specially appointed for the purpose of conducting systematically such an examination of workers at present employed between such ages.

On the results of this preliminary medical examination, it would be a simple matter to classify the various processes in the order of the amount of risk entailed; the most dangerous could then be added to the non-lead processes enumerated in the Schedule, in order that the workers employed in those processes should be subjected to a yearly examination at the hands of the Certifying Surgeons. At the same time, a system of compensation could be established, the cost of which should be defrayed in whatever manner appeared to be most fair, having regard to the varying

* See page 41.

amount of danger involved in employment in each of the several processes so scheduled as compared with the incidence of similar diseases among the general population of the district.

It is only reasonable to assume that the careful observance of the rules, if revised as the Committee propose, will in due course result in a material reduction of the excessive lung disease among workers in potteries: if, therefore, the scheme of compensation were founded on the proportion between the industrial rate attack from such diseases and that of the general population, the results of the Certifying Surgeon's *annual* examinations could also be utilised from time to time—say every five years—to readjust the scheme of compensation.

The above proposals are the outcome of a very careful investigation of the question by Dr. Reid, a member of the Committee (see Appendix XXXIV.), and it is hoped that they will receive consideration when the next extension of the provisions for workmen's compensation is being drafted.

It may be mentioned that evidence was given by several witnesses in favour of a suggestion made by Mr. Thomas Edwards, a member of the Committee representing the Dippers' and Ovenmen's Union, that employers and employed should contribute jointly to a fund from which additional compensation could be granted, to supplement that at present payable by law. This suggestion also the Committee consider to be worthy of due consideration, but as it does not seem to be quite germane to the present inquiry, they refrain from making any comments on it.

Overalls and Head-coverings.

The question of workers wearing overalls and head-coverings received the careful attention of the Committee, and a great deal of evidence was taken on the subject. A few witnesses advocated the extension of this requirement to such classes of operatives as towers and tile makers; certainly these processes, as at present carried on, seem sufficiently dusty to warrant it, but the Committee expect that the local exhaust ventilation will be so greatly improved in the near future that the need for such a rule will disappear; they do not, therefore, recommend the extension of this provision to any fresh operations, but suggest its retention, save only so far as it concerns the wearing of head-coverings by majolica paintresses, in all those to which it is now applicable.

It was borne in on members of the Committee, when visiting potteries, that there is a strong tendency on the part of workers to wear the head-coverings rather as an ornament than as a protection. In the case of women and girls, especially, it was noted that the hair was more or less elaborately arranged and the cap so worn as to be, to all intents and purposes, useless as a safeguard against dust. It is easy to understand how such a custom has arisen, but it must nevertheless be strongly discountenanced, and a regulation requiring the head-covering to be worn in such a manner as to protect the hair effectually must be strictly enforced.

The present rules require the employer to provide and maintain suitable overalls for women and young persons, but medical men, inspectors, and operatives alike urged the advantages of making him responsible for all such garments, instead of, as at present, leaving the adult men to provide their own. In Appendix XXXVI. will be found a list of thirteen codes of Special Rules and Regulations, relating to other trades, which enact that the occupier shall provide overalls for all workers, and the Committee recommend that the regulation requiring overalls to be worn in certain processes in potteries, should be drafted on similar lines. The attention of the Committee has, moreover, been called to certain potteries where the practice prevails of supplying waterproof aprons to be worn, outside the overalls, by all workers who are liable to be splashed with lead glaze; this they believe to be an admirable precaution, as the waterproof material can be sponged daily; they understand, moreover, that its universal application would not be objected to on the score of expense or on any other grounds. In some cases it may be preferable to have the overalls themselves, or the front portions of them, made of a light waterproof material; if these are designed so as to provide adequate protection from splashes or

dust, the overalls of cotton or similar material need not be worn in addition. The Committee recommend the adoption of a regulation to give effect to these suggestions.

The rule regarding the washing of overalls is at present somewhat vague; it merely specifies that "suitable arrangements shall be made by the occupier," and leaves it open to him, if he is unwilling to take upon himself the cost, either—

(i.) to charge the workers for the washing, or

(ii.) to arrange for each worker to take his or her own overall home to be washed.

(i.) The former practice is open to grave objection, as being opposed to the principle that the manufacturer, in whose factory the dangerous materials, such as lead, are used, should also bear the cost of the necessary precautions to prevent illness occurring among his workers.

(ii.) The latter arrangement was condemned in unqualified terms by nearly all witnesses examined on the point, including eleven medical men as well as employers and inspectors. They considered that, if the overalls are taken home, there can hardly fail to be dust shaken from them and scattered about the dwelling rooms of the workers, and strongly maintained that overalls should be washed at the factory or at a recognised laundry at the occupier's expense. With this view the Committee are in complete agreement, and recommend the following regulations:—

> The occupier shall provide and maintain suitable overalls and head-coverings for all persons employed in the processes included in the Schedule; except that head-coverings need not be provided for majolica paintresses.
>
> The occupier shall provide and maintain suitable aprons of a waterproof or similar material which can be sponged daily, for all dippers, dippers' assistants and ware cleaners; provided that if the front of the overall supplied to any such worker in pursuance of the preceding paragraph is made of a material which can be sponged daily, no separate apron need be provided for that worker.
>
> All aprons made of a waterproof or similar material, and all overalls or parts of overalls made of such material, shall be thoroughly cleaned by sponging or other wet process after every time of use. All other overalls or parts of overalls and all head-coverings shall be washed or renewed at least once a week; and the occupier shall provide for washing, renewal, and necessary repairs of all overalls and head-coverings to be done either at the factory or at a laundry; and no worker shall be allowed to take home any overalls, head-coverings, or aprons provided in pursuance of this regulation.
>
> Head-coverings shall be adequate to protect the hair from dust, and shall be worn in such a manner as to be effective for this purpose.

Storage of overalls and head-coverings.—Minor amendments to the existing rule were advocated by operatives and inspectors, with a view to securing adequate accommodation, in all cases, for the proper custody of the overalls and head-coverings when not being worn. For this purpose suitable cupboards are essential, but owing to the wide difference in the construction of various potteries it is difficult to recommend any definite spot where they should be placed. If sufficient space is available, there seems to be no valid objection to utilising lavatories for the purpose, or any other place inside or outside the door of the workroom and close to it. The Committee feel that this is a point which can properly be left to the discretion of the Factory Inspector and in order to enable him to prevent the use of unsuitable places it is only necessary to provide that they shall be "suitably situated." The Committee therefore suggest a regulation worded as follows:—

> All overalls, head-coverings and aprons provided in pursuance of this regulation, when not in use, or being washed or repaired, shall be kept by the occupier in proper custody; for this purpose the occupier shall provide a cupboard or cupboards or room or rooms suitably situated and sufficiently large to hold the overalls, head-coverings, and aprons; a separate peg shall be provided for each worker who is required by these regulations to wear overalls.

Storage of Outdoor Clothing put off During Working Hours.

Evidence was given by inspectors and operatives showing that the provision of cloak-rooms for the outdoor clothing of workers employed in scheduled processes is not always satisfactory. The present rule regarding this is not very clear, and witnesses asked for a definite regulation specifying separate cupboards and other necessary accommodation. The Committee accordingly recommend that:—

> A cupboard or cupboards or room or rooms shall be provided by the occupier for workers to deposit clothing put off during working hours; the accommodation provided for this purpose shall be sufficient to hold the outdoor clothing of all workers who are required by these regulations to wear overalls, and a separate peg shall be provided for each such worker; all such cupboards or rooms shall be entirely separated from any source of lead or other dust and from any place provided for the storage of overalls, head-coverings or aprons, and shall be kept thoroughly clean by the occupier.
>
> The occupier shall make adequate provision for drying outdoor clothing, if wet, during the time that it is put off in working hours; this provision shall not be made in any place where there is any source of lead or other dust, or in any place provided for the storage of overalls, head-coverings, or aprons, or in any mess-room provided in pursuance of these regulations.*

Mess-rooms.

Another question of great importance is that of mess-room accommodation for workers employed in rooms where dangerous processes are carried on,† and many witnesses were examined on the subject; they were all of opinion that no food ought to be admitted to such places, and several indicated that the present arrangements made for workers during meal-times are often very inadequate. Complaints were made by three manufacturers that the workers are reluctant to use the mess-rooms when provided; but these, and all other employers questioned, none the less agreed that such rooms should be provided, and should be clean, light, airy, and properly warmed in winter.

It was pointed out in evidence that the present rule is, in this case also, not sufficiently definite; it was, accordingly, urged by various witnesses that all manufacturers should be required by the regulations to provide tables, seats, and lockers for the storage of food, as well as adequate cubic space. It was further maintained that no manufacturer ought to be excused from equipping proper mess-rooms on the ground that his works are closed at meal-times, but that it should be permissible, if inconvenient to give up sufficient space for such mess-rooms in the factory itself, to provide the necessary accommodation at any place close to the factory and readily accessible from it.

Witnesses were unanimous in the view that the employers should be held responsible for maintaining the mess-rooms in a cleanly and habitable condition, but there was some division of opinion regarding the necessity for separate accommodation for females: the Committee understand that in large factories this principle is generally adopted, and consider that in all such works distinct rooms for the two sexes are essential. They recognise, however, that there are obvious difficulties with regard to smaller factories, and, as they are not convinced that separation is practicable in every case, they do not recommend a rule to that effect; they, therefore, think that a proper standard of mess-room accommodation can be secured by the enforcement of the following regulations:—

> No person shall be allowed to keep, or prepare, or partake of any food, or drink, or tobacco, or to remain during meal-times in any place in which is carried on any process included in the Schedule, or the process of towing, or that of tile-making, or any other which the Inspector of Factories for the District shall certify as sufficiently dusty to render the room in which it is carried on an unsuitable place, in his opinion, for persons to remain during meal-times.
>
> Mess-room accommodation shall be provided for the workers employed in the processes named in the Schedule and for such others as are excluded

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* See page 109.

† In addition to scheduled processes, it is clearly desirable to include, for the purposes of the mess-room regulations, also towing, tile-making, and other dusty processes.

from their own workrooms during meal-times in pursuance of the preceding paragraph.

This accommodation shall consist of a clean, well ventilated, and well lighted room or rooms in which no manufacturing process is carried on; it shall be at or near the factory, and shall be sufficiently large to accommodate all the workers employed in the processes named in the Schedule and all others who are excluded from their own workrooms during meal-times in pursuance of these regulations, allowing floor space in accordance with the following scale*:—

In mess-rooms for—

6 persons and under	- - -	$10\frac{1}{2}$ sq. feet per person.
Over 6 persons and up to 12	- -	$7\frac{1}{2}$,, ,,
,, 12 ,, ,, 20	- -	6 ,, ,,
,, 20 ,, ,, 28	- -	$5\frac{1}{2}$,, ,,
,, 28 ,, ,, any number	-	5 ,, ,,

Provided that if the Factory Inspector for the District shall certify that in his opinion the special circumstances of any factory are such as to render the provision of mess-room accommodation for all such workers unnecessary, it shall be sufficient to provide accommodation, calculated on the above scale, for such a proportion of all such workers as is named on the certificate of the Factory Inspector; but in no case shall this proportion be less than 50 per cent., subject, in cases of difficulty, to appeal to H.M. Chief Inspector of Factories; and the Factory Inspector for the District shall have the right, at any time, to cancel or amend any such certificate.

All mess-rooms provided in pursuance of this regulation shall be furnished with proper tables and seats, shall be kept at a proper temperature not below 55 degrees Fahrenheit, and shall be thoroughly cleaned daily at the occupier's expense.

No person shall be allowed to take into a mess-room any overall, head-covering or apron worn in a process named in the Schedule.

The washing conveniences prescribed by the regulations shall not be maintained in any mess-room.

Temporary storage of food.—A suitable place for the deposit of food shall be provided for each worker using the mess-room. Such provision shall not be made in a room in which any manufacturing process is carried on, and shall be subject in each case to the approval of the Factory Inspector for the District.

Heating of food.—Adequate facilities shall be provided to enable workpeople to heat their food.

Supply of Milk for Lead Workers.

Many of the medical witnesses pointed out the importance of having regular meals as a means of combating the possible ill-effects of working in a lead process, and special stress was laid on the danger of beginning such work in the morning without having first breakfasted. Recent researches by Dr. K. W. Goadby and Mr. W. Thomason (see Appendices XXV. and XXVI.) tend entirely to confirm this view. Sir Thomas Oliver spoke strongly of the value of milk as a preventive of lead poisoning; nine witnesses, including medical men, employers and operatives, urged that milk or some equivalent nourishment should be supplied to lead workers, especially women and young persons, before work begins, and as already stated on page 9, a number of manufacturers have made such provision for years past. One of the operatives stated that certain lead workers were known to be seldom able to get a good breakfast. On the other hand, it was pointed out that some workers might not be able or willing to take milk, but the Committee recommend a rule as follows, and think that it will prove as practicable as it will undoubtedly be beneficial:—

A supply of milk, or cocoa made with milk, shall be provided for all women and young persons working in scheduled lead processes who commence work before 9 a.m. Not less than half a pint shall be provided for each worker at the expense of the occupier.

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* For particulars of the considerations on which this table is based, and examples of suitable seating arrangements in mess-rooms, see Appendix XXXV.

It shall be compulsory on the worker to drink the milk or cocoa, unless a medical certificate is produced, stating that such nourishment is unsuitable for him or her.

Lavatories.

Witnesses were entirely in accord as to the importance of personal cleanliness as required by the existing rules, but differed somewhat as to the adequacy of the present arrangements for its promotion; several Factory Inspectors and others stated that really good lavatories were not often to be found in potteries; it is not, for example, as yet compulsory to supply hot water, but its provision was advocated by no fewer than 23 witnesses, and in support of it the regulations were quoted which apply to the following trades*—

Electrical accumulators,
Paints and colours,
Heading of yarn,
Nitro-benzine,
Horse hair.
White lead,
Red and orange lead,
Yellow lead,
Lead smelting,
Enamelling iron plates,
Tinning and enamelling metal hollow-ware and cooking utensils,
Tinning and enamelling iron hollow-ware,
Lucifer matches,
Chrome processes.

In all these trades the provision of either hot or warm water is compulsory. The attention of the Committee was directed to the form of regulation incorporated in the more recent of the above codes, and they recommend the adoption of a similar wording, which allows the occupier the alternative of either basins with hot and cold water, or a trough with a constant supply of warm water.

According to the evidence, one basin for every five workers, or an equivalent length of trough, is not sufficient if workers wash in considerable numbers at one time; many witnesses, including medical men, inspectors, employers, and operatives expressed themselves in favour of a time allowance for washing, and the Committee think they can best give effect to this suggestion by following the wording of Regulation 13 of the code relating to Electric Accumulators.† As a large number of lead workers in potteries are employed on a piece-work system, it was thought at first that an appreciable hardship might be involved in any provision requiring the allowance of time for washing; the point was very carefully considered by the Committee, but they have formed the conclusion that the application of the same rule for pieceworkers and day workers alike offers so many advantages that it should be adopted if possible. Such a regulation may entail a slight encroachment on the spare time of the former by reason of their having to remain a little later at the factory in the evening to complete the same amount of work, but they will, the Committee feel sure, readily agree to it for the benefit of the workers as a whole.

The evidence further showed that the maintenance of lavatories has not always been satisfactory, and the Committee consider that the employer's duty to have them kept in a thoroughly clean and proper condition should be clearly brought out in redrafting the rules.

The present rules specify a minimum space of 21 inches both in length and breadth for the worker to stand in while actually washing, and require the lavatories to be placed as near as practicable to the places where the workers who have to use them are employed. Both these rules were referred to in evidence as valuable, and should certainly be retained. There is, however, yet another point

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* See Appendix XXXVI.
† Regulations for the Manufacture of Electric Accumulators, 1903.

to be considered. The attention of members of the Committee has been called to lavatories fitted up in an outhouse, outside the door of which operatives have had to stand in a queue in all weathers; there appears, therefore, in addition, to be need of a clause requiring provision of suitable and sufficient space under shelter where workers may await their turn to wash.

Towels.—The evidence given before the Committee also shows that a very definite rule is required regarding the supply of towels; several methods of replacing them periodically, when dirty, were described, and various opinions expressed as to what in this respect should be regarded as sufficient. The Committee think that either roller towels or a separate plain towel for each worker of a minimum size should be prescribed by the rules, and that all towels should be washed or renewed daily at the occupier's expense.

Nail brushes.—A large nail brush, maintained in good condition, is requisite for each basin or equivalent length of trough, and it is a common practice to fasten it down in order to prevent its being stolen; the Committee consider that a clause is necessary to ensure that all such brushes are taken up frequently and cleaned, and renewed from time to time, as otherwise they must inevitably become filthy and quite unfit for use.

Soap.—A sufficient supply should be always available; evidence was given which indicated laxity in many factories in regard to this requirement.

Separation of sexes.—It is not at present compulsory to provide separate lavatories for males and females; such separation was, however, strongly advised by medical men and factory inspectors, and witnesses representing the manufacturers, while doubtful as to the necessity of it, did not greatly oppose the proposal. In some cases, where the relative numbers of men and women vary considerably, it has been suggested that a movable partition across the lavatory might save much expense, and the Committee see no objection to such a method of securing privacy for the female workers.

Chemical washing.—Several witnesses spoke of the advantages of using soluble sulphides in the water in which the hands are finally rinsed; these convert any lead salts still remaining on the skin into lead sulphide, which, being black, indicates that the lead has not been completely removed, and consequently acts as an inducement for a further and more thorough washing; such lead sulphide also possesses an additional advantage inasmuch as, being insoluble, it is not, even if left on the hands, readily absorbed into the system. There might be serious practical difficulties involved in introducing this new principle into the lavatories provided for all lead workers on a pottery, and the Committee therefore suggest that it should be tried in the first instance in the special lavatories to be provided in the lead-house or glaze-mixing room, as recommended on page 66. If the chemical rinsing is found to be useful and readily applicable in these special lavatories, it should be extended later to all lead workers' lavatories.

The Committee's recommendations are as follows:—

The occupier shall provide and continually maintain, for the use of all persons employed in processes named in the Schedule, at least one lavatory basin for every five such persons. Each such basin shall be provided with a waste pipe and plug, or the basins shall be placed on a trough fitted with a waste pipe. There shall be a constant supply of hot and cold water laid on to each basin.

Or, in the place of basins the occupier shall provide and maintain troughs of enamel or similar smooth, impervious material, in good repair, of a total length of two feet for every five such persons employed, fitted with waste pipes, and without plugs, with a sufficient supply of warm water constantly available, from taps or jets above the trough at intervals of not more than two feet.

The lavatory shall be kept thoroughly cleaned at the cost of the occupier.

Before each meal and before the end of the day's work, at least ten minutes, in addition to the regular meal-times, shall be allowed for washing to each such person, provided that if the lavatory accommodation specially

reserved for such persons exceeds that required by the preceding paragraphs, the time allowance may be proportionately reduced, and that if there be one basin or two feet of trough for each such person, no allowance of time shall be required.

The lavatories shall be under cover and shall be fitted up as near as practicable to the places in which the workers for whom they are provided are employed.

There shall be in front of each washing basin, or trough, a space for standing room which shall not be less in any direction than 21 inches.

Sufficient space shall be provided under cover in or adjoining the lavatory for such workers as use the lavatory while awaiting their turn to wash.

Towels.—One roller towel, fastened in position, at least 15 square feet in area, shall be provided for every three workers, and shall be washed or renewed daily.

Or, one roller towel, fastened in position, at least 15 square feet in area shall be provided for every nine workers, and shall be washed or renewed after every meal-time and at the close of the day's work.

Or, a towel at least 5 square feet in area shall be provided for each worker, and shall be washed or renewed daily. In this case a peg with the worker's name shall be provided for each towel.

Nail brushes.—One nail brush shall be provided for each basin or every two feet of trough, and shall be maintained in a cleanly and efficient condition. If fastened down, it shall be taken up once a week, and cleaned or renewed.

Soap.—A sufficient supply of soap shall be always available at each basin or every two feet of trough.

Separation of sexes.—Separate lavatories for males and females shall be provided. An adjustable wooden partition across a lavatory shall be deemed to be sufficient separation, provided that it ensures complete privacy for females while washing.

Chemical washing.—A solution of soluble sulphides shall be provided for workers in the lead house in which they shall rinse their hands after washing so as to show if they are free from lead.*

Separation of Processes by Means of Different Rooms.

This point has already been dealt with in the case of certain minor processes such as "threading-up,"† "thimble picking,"‡ and "looking over biscuit ware"§; but the still more important question of separating all scheduled dangerous processes from less hazardous occupations now calls for consideration.

Several witnesses tendered evidence on this point, and suggested that all persons employed in a place where a scheduled process is carried on should be subject to the same regulations for the protection of their health—*e.g.*, periodical medical examination, use of lavatories, etc.—as if they were actually engaged in the scheduled process in question. H.M. Inspectors of Factories cited instances in which operatives, employed in a process not named in the Schedule, have been called upon to work in dangerous proximity to some scheduled process, and leading manufacturers agreed as to the advisability of preventing any such practice. The Committee accordingly recommend that:—

When a scheduled dangerous process is being carried on in a room where other work is also done, either the place where the scheduled process is carried on shall be screened off from the rest of the room by a partition not less than 8 feet high;

Or, all persons working in the room shall be deemed to be persons employed in the scheduled process.

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* Mr. Vernon Harcourt recommends a solution of Ammonium sulphide, to be used in the strength of ½ oz. to 1 gallon of water.

† See page 71. ‡ See page 81. § See page 87.

Exclusion of Women from Lead Processes.

The advisability of excluding women from employment in lead processes has, on two distinct grounds, been forcibly brought to the attention of the Committee, the one being the belief that they are more susceptible than men to lead poisoning, the other that such work has an effect on them prejudicial to their child-bearing functions.

Exclusion of women from lead processes on the ground of their greater susceptibility to lead poisoning.

The greater susceptibility of women to lead poisoning as determined by the extent to which the non-fatal attack rate among them is in excess of that among males, has already been shown in the statistics quoted under the headings of dippers,* dippers' assistants,† ware cleaners,‡ etc., as well as by the general table for all lead workers.§ In view of this fact the opinion was expressed by many witnesses that all women ought to be excluded, if not from all lead processes, at any rate from the most dangerous.

The attainment of this object, it was pointed out, could be secured with the smallest amount of hardship by preventing the engagement of all women for work in such processes in the future, and if the present bad conditions of labour were to continue, there would, no doubt, be grave necessity for such a restriction. The Committee, however, anticipate that the stringent recommendations which they have made in respect of the processes in question will, if adopted, serve effectually to protect the workers, and, seeing that if the exclusion of women were carried into effect it would inevitably cause serious disturbance in the trade, they do not consider that the present is the proper moment for advocating such a policy even in respect of the dipping house processes. The matter is rather one for future decision; if the proposed precautions have the desired effect and there is a marked decrease in the number of lead poisoning cases among women, there may be no need for their exclusion; if the precautions fail in this object, the further experience will facilitate the adoption of such drastic measures as may be necessary.

Exclusion of married women from employment in lead processes.

The question as to the fitness of married women for employment in dangerous processes has, from a general point of view, been for some time the subject of special inquiry. On the 17th December, 1907, the Under Secretary of State issued a circular letter to the Medical Officers of Health in representative industrial districts throughout the country, for the purposes of ascertaining whether the employment of women in a factory or workshop before and after child-birth has an effect prejudicial to the health of either mothers or children; in this letter it was incidentally pointed out that information in respect of miscarriages would also be useful.

The inquiry was carried out in the course of 1908 and 1909 at the homes of the workpeople, and Dr. Reid, a member of the Committee, was in charge of it so far as North Staffordshire was concerned. The Committee have accordingly had the benefit of his investigation, the results of which will be found summarised in Tables A and B of Appendix LII.

From these tables it will be seen that 31 out of 121 mothers who were lead workers previous to marriage, and 21 out of 70 mothers who worked in lead processes after marriage, were subject to miscarriages; and that the respective numbers of miscarriages sustained by those affected were 78 and 58. Compared with artisan mothers, the particulars with regard to whom are also given in the tables, the percentages of lead workers previous to marriage who miscarry is $2\frac{3}{4}$ times as great, and the miscarriages per 100 mothers nearly three times as numerous; the excess shown by a similar comparison in the case of lead workers after marriage is even more pronounced; the percentage of those who miscarry is over three times as great, and the number of miscarriages per 100 mothers nearly four times.¶

* See pages 67 and 68. † See page 70. ‡ See page 75.
§ See pages 96 and 97.

¶ It does not appear from the tables that working in lead has any influence in lowering the birth-rate, nor is there any evidence to show that the children of lead workers are any less healthy than those born of non-lead workers.

So alarming a tendency to miscarriage was very naturally considered by the Committee as a further reason for the exclusion of at any rate married women from dangerous lead processes, but, while the conclusions to be drawn from the figures are too startling to be ignored, it may be contended that their importance is seriously diminished by the paucity of the data. It was, therefore, suggested that the statistics might be supplemented by further particulars collected by questioning the mothers actually engaged in lead work at the present time.

An investigation was accordingly initiated on these lines by Dr. Reid in 60 factories, and the results of it* point to an entirely different conclusion; if, indeed, they are to be accepted and it is assumed that the figures for non-lead workers in the first inquiry represent normal conditions, it would follow that lead work, instead of inducing miscarriages, would tend to prevent their occurrence.

In view of so surprising an outcome, Dr. Reid pointed out in his evidence the serious risk which existed of the object of the inquiry having been too well recognised; it was possible, he maintained, that the women had regarded it as a preliminary to their definite exclusion from work in lead processes, and that consequently they had understated the number of their miscarriages, so as to avoid imperilling their employment; he considered, therefore, that in spite of every assistance given by the manufacturers to ensure the returns being correct, there was no alternative but to look upon the data obtained as of doubtful accuracy.

Be this as it may, there can be no doubt that the figures of Dr. Reid's first inquiry are very disquieting; the extreme gravity of such an excessive rate of miscarriage cannot indeed be overestimated, and were it the only consideration, it would, without doubt, be necessary to take immediate and drastic measures. But there are three other points which have equally to be weighed; in the first place, as already mentioned with reference to the susceptibility of women, it may be expected that, in view of the precautions recommended in this report, the liability of lead working mothers to miscarriage will in itself be considerably reduced; in the second, it must be admitted that the statistical basis on which to take action is too limited; and thirdly, seeing how grave the rate of miscarriage appears to be among women workers in lead before marriage, the exclusion of only married women would not in itself serve as an effectual preventive.

Further records of miscarriage.

Under these circumstances the Committee do not feel justified in advocating the immediate exclusion of women, whether married or unmarried, from such work, but they consider that the attention of the authorities should none the less be concentrated on the subject with a view to dealing with it, if necessary, in the near future.

For this purpose, the publication of the full results of the Home Office inquiry into the conditions of maternity throughout the country, which may shortly be expected, may give most useful information; if tables are issued showing the relative incidence of miscarriage in trades in which women are employed in lead processes analogous to those in potteries, and if the records prove to be drawn up on lines which render them comparable with Dr. Reid's tables, the report cannot fail to be of the utmost importance.

Again, the Notification of Births Act, 1907, confers powers on local authorities to require the registration of all still births occurring in the last two months before full term; as such, the information it would yield might possibly be somewhat limited; in all probability it would not, for example, bear on working conditions which tend abnormally to increase the liability to miscarriage in the early months of pregnancy, but the adoption of the Act by local councils controlling pottery areas might well lead to the collection of useful statistics, and the system of registering such occurrences, once inaugurated, could, with little difficulty, be extended.

But a more complete source of information is to be found in the assistance of the Certifying Surgeons, whose duty it is to examine lead workers once in every

* See Tables C and D of Appendix LII.

calendar month. Being thus in a favourable position for gaining information, they should be instructed to make regular inquiry, to record details of every case in which they find that such an occurrence has taken place, and to report the particulars to the Home Office, so that in the course of a year or so more reliable statistics of miscarriages among lead working mothers may be obtained.

The Committee realise that the difficulties involved in any attempt to collect comparable statistics of miscarriage are very great; should they prove to be insuperable, then any action to be taken must be based on the records of actual lead poisoning alone. Such a course would no doubt be equally satisfactory, for it may be logically inferred that, if the danger of poisoning is reduced, the risk of miscarriage arising from exposure to lead must be decreased in a similar degree.

Conclusions regarding the exclusion of women from lead processes.

To sum up briefly, therefore, the Committee consider that the danger to women working in lead processes, whether it shows itself in the form of actual lead poisoning or in increased liability to miscarriage, should be very greatly mitigated, if not actually removed, by the very strict observance of the proposed precautions; if this, however, should not prove to be the case, then—seeing that the excessive miscarriage rate among those who were lead workers only before marriage, though not apparently so great as among those who subsequently continue such work, is nevertheless considerable—all women under 45 years of age should be excluded from employment in the most dangerous lead processes.

It will be remembered that in the opening paragraph of this report it was pointed out that questions might arise on which the Secretary of State might desire to call the Committee together again and consult it further. Of these, the exclusion of women from lead processes is an instance in point. On this subject the Committee recommend that no immediate action be taken, but that, during an interval of two years after the new regulations come into operation, every effort be made to collect reliable statistics which will show the results achieved by the proposed precautions, and that, at the end of that period, it be considered whether any steps in the direction of such exclusion are necessary or desirable in the light of the additional statistics which will then be available.

Exclusion of Women at time of Child-birth.

Evidence was also given as to the need for excluding women for some definite period both before and after child-birth; the present law forbids employment at a factory or workshop for one month after such occurrence, but witnesses generally advocated, in the interest of the children, a considerable extension of this period.

Seeing, however, that a full investigation of these matters and their bearing on the high rate of infantile mortality in industrial centres generally is at present being made through the Home Office, it is undesirable for this Committee to formulate any recommendations on the subject. It seems probable, however, that the rate of infantile mortality will be demonstrated to be increased by the shortness of the mother's absence from work after child-birth; this is clearly not a case for a provision applying to one industry alone, but the Committee hope that the period will be raised to at least three months for industrial mothers generally, and that a national scheme of maternity insurance will be established to secure a maintenance allowance to every working mother during her enforced absence from employment.

RECOMMENDATIONS APPLICABLE TO EMPLOYMENT IN ALL DEPARTMENTS OF POTTERIES.

Ventilation.

1. *Exhaust Draughts for the Removal of Dust.*

The importance of constantly maintaining an efficient system of local exhaust draughts for removing the dust generated in many operations carried on in

potteries was very clearly brought out in evidence, and has already been referred to in the pages of this Report when dealing with those processes in detail. Reference has also been made to the reports of Mr. Pendock* and Mr. Duckering,† which deal with the conditions of ventilation and the various quantities of dust found in the air of workplaces in potteries, and entirely corroborate the testimony put before the Committee as to the widespread defects in existing installations for the removal of dust, whether of lead compounds or other materials.

The exhaust apparatus consists, as a rule, of a fan, connected by a wide pipe or duct with openings placed as near as possible to the points at which dust is generated by the workers; usually also some form of air-guide, known as a "hood," is fitted over the part of the work bench where the dusty operation is carried on, in order to concentrate the draught of air in the direction of the opening into the duct.

Exhaust fans and ducts.—These should be so placed and designed as to afford as direct a passage as possible for the dust-laden air, and care should be taken to avoid all sharp bends, constrictions, or other obstacles likely to interfere with the free flow of the air-currents.

Details of many defects noted in existing arrangements of exhaust fans and ducts will be found in Part I. of Appendix XLVIII., and the grave loss of efficiency thereby occasioned is very apparent from the charts in Part II. of the same Appendix. The Committee are strongly of opinion that the attention of manufacturers should be specially directed to these defects, and that they should be required, within a reasonable time to reconstruct their apparatus in such a manner as to ensure, in every pottery, a system of local exhaust draughts which will be not only efficient in design, but also capable of being readily maintained in good working order.

Hoods.—It is very desirable that, whatever the operation, the work should be done entirely within a suitable hood. Members of the Committee have themselves carried out a series of experiments with the object of testing the relative merits of different types, and the accompanying illustrations show four useful varieties. These have been designed for the purpose of increasing the efficiency of the exhaust draught, and, while there is no suggestion that the adoption of any of them should be made compulsory, it is hoped that the sketches will materially assist manufacturers in designing hoods which, when adapted to particular processes, will achieve the object in view.

The introduction of such hoods does not, however, appear to be always practicable, and the following regulation is therefore recommended:—

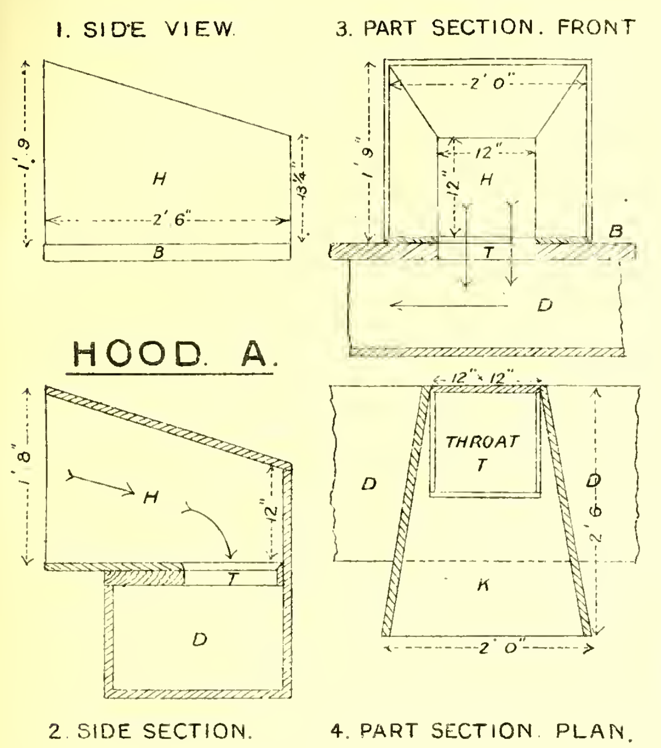
> Every process for which an exhaust draught is prescribed shall be carried on inside a hood or exhaust funnel; provided that, where the occupier can show that this is impracticable, it shall be sufficient if the work is done within the effective range of an exhaust opening.

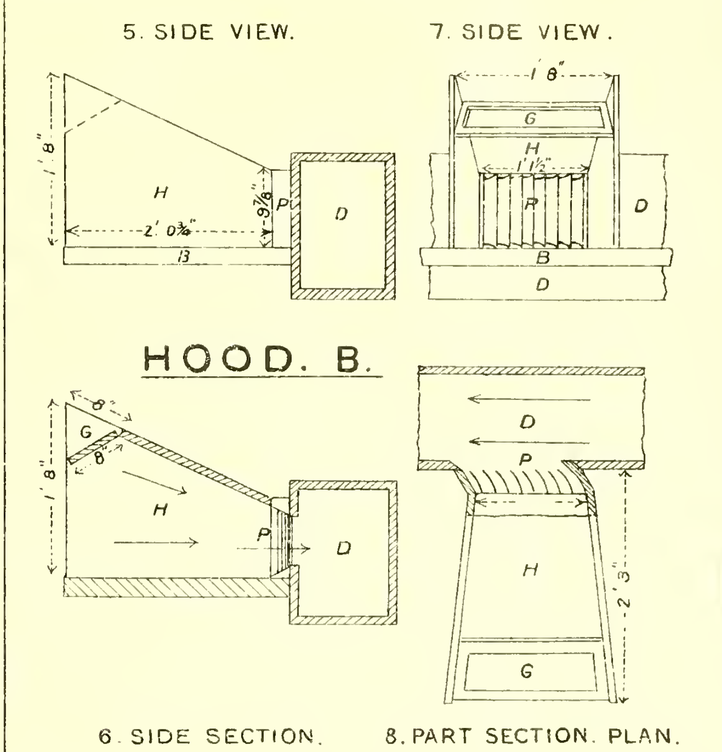
Throats.—The openings from the hoods into the duct, through which the dust-laden air is drawn, are generally spoken of as throats. The most economical effect can in many cases be secured by means of short branch pipes curved towards that end of the duct at which the exhaust fan is situated, but in some there is insufficient space to admit of any such arrangement; the Committee, therefore, desire to call attention to the device illustrated in figures 5 to 15 which they have themselves tested and found to be very efficient.

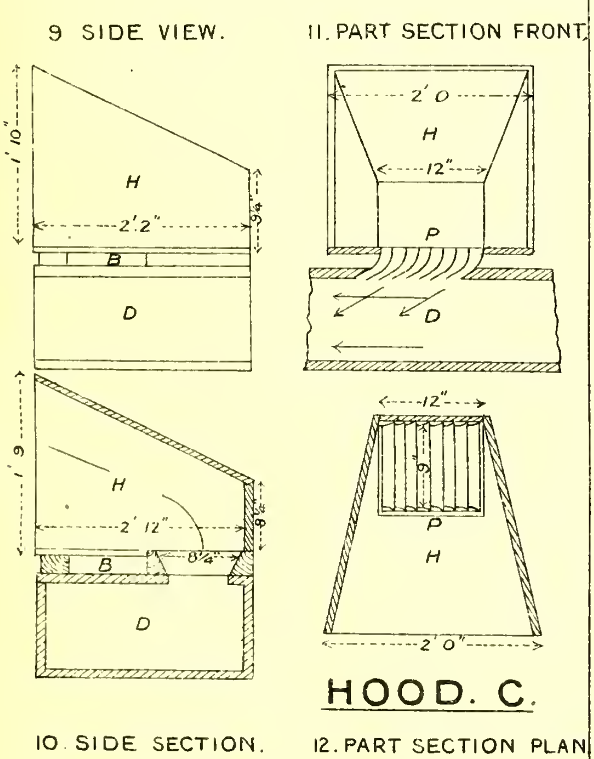
Standard of exhaust draught.—The utility of an exhaust draught depends largely on its velocity, and, after conducting a series of experiments, the Committee suggest the adoption of a regulation specifying a speed of 100 *linear feet per minute* as a minimum standard. The measure of such speed, if the work is carried on entirely within the hood, should be taken at the entrance to the hood; but if the work is done wholly or partially outside, the point of measurement should be the vertical plane passing through the front edge of the whirler, *i.e.*, the revolving stand or table on which the article of pottery is placed during the process for which the use of

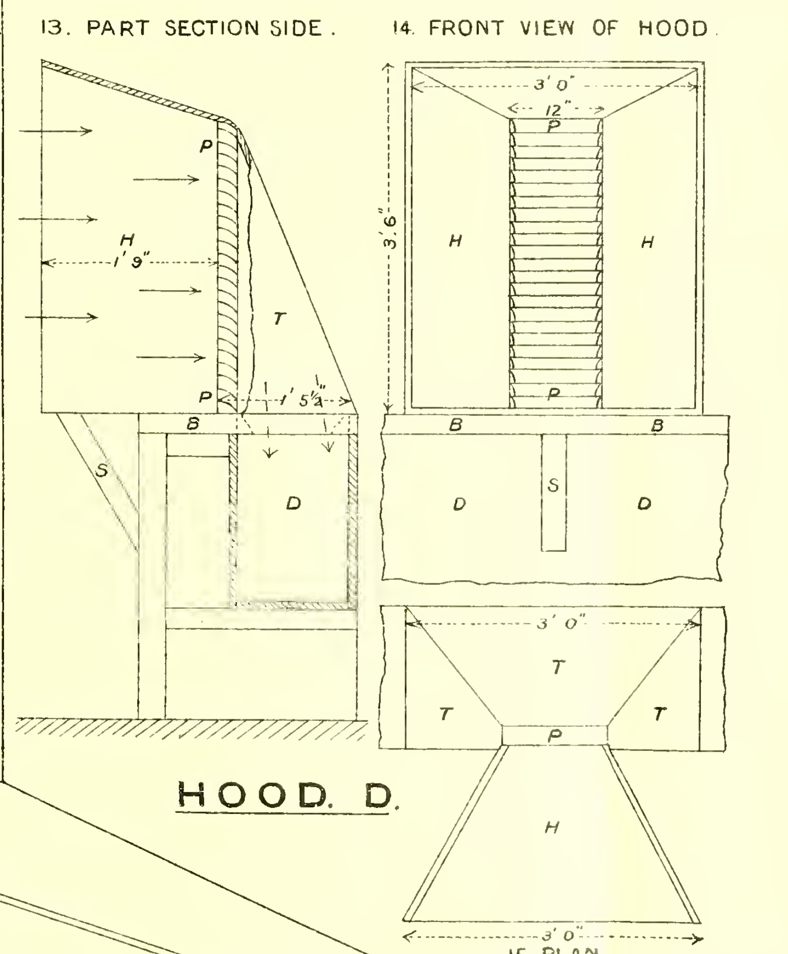
*Appendix XLVIII. † Appendix XLIX.

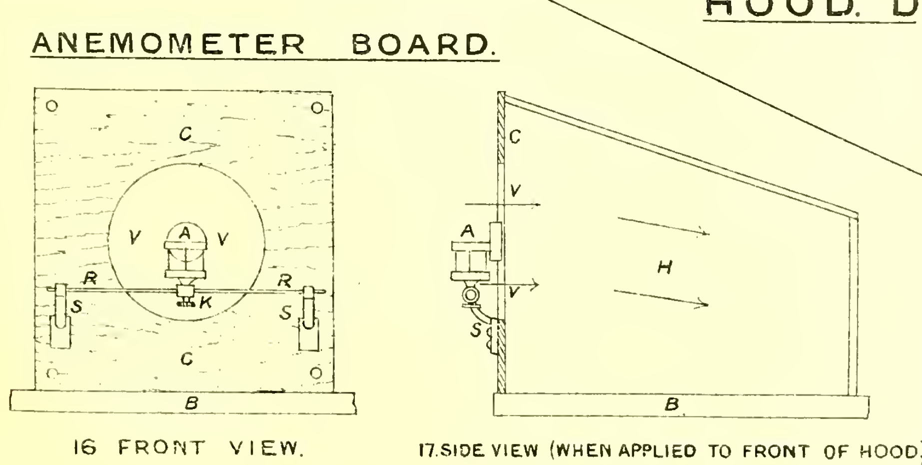
VARIOUS HOODS ETC. USED IN VENTILATION EXPERIMENTS.











REFERENCES	FIG
A. ANEMOMETER.	16. 17
B. BENCH	A 11
C. TESTING BOARD	16. 17
D. DUCTS LEADING TO FAN	A 11
G. GLASS FRONT (ADJUSTABLE)	5 8.
H. HOODS	A 11
V. OPENING IN C (1 SQ FOOT)	16 17
P. SPECIAL INDUCTORS	5 15
R. ANEMOMETER ROD	16 17
S. SUPPORTS	13. 17

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Weller & Graham Ltd Litho. London.

a local exhaust draught is required; if no revolving stand is used, the front edge of the work itself should be substituted for that of the whirler.

A convenient method for determining the velocity, in cases where the work is done entirely within a hood whose frontal opening is all in one plane, is as follows:—

(*a*) The front of the hood is partially closed by means of a board containing a circular aperture of area one square foot, and the velocity in feet per minute of the air current passing through this opening is ascertained by means of an anemometer placed at the centre of the circular aperture. (See illustration facing the preceding page: figures 16 and 17.)

(*b*) The anemometer reading, obtained as above, is divided by the number of square feet of the frontal opening of the hood.

The Committee recommend that no exhaust draught should be deemed to be efficient if the number of linear feet per minute, ascertained as set forth in paragraph (*b*), is less than 100, but they offer this suggestion purely as a tentative one, devised for the purpose of overcoming to some extent the difficulty of measuring low velocities anything like accurately with an anemometer. They deem it to be of the greatest importance to have a definite minimum standard such as the 100 linear feet per minute above mentioned; but they find that it is hardly possible, even after considerable experimental work done by them, to prescribe a velocity standard which will be applicable to all processes; while 100 feet per minute has been found a suitable minimum in some cases, it will doubtless prove in practice that in some instances a higher velocity is needed to ensure the efficient removal of dust, and that in some, perhaps, a lower one would suffice.

Owing, however, to the limited range of Mr. Duckering's observations, for which see Appendix XLIX., the Committee do not possess sufficient actual data upon which to found any definite recommendations on the subject, and their proposal is merely made as a basis for further experimental work.

In the meantime it is essential that manufacturers shall give the most careful attention to the proper maintenance of their exhaust appliances, by causing them to be frequently examined for the purpose of seeing that the fans are clean and running freely, that the driving belts are gripping the pulleys, that the ducts are clean and free from obstruction, and the exhaust plant generally in efficient working order.

Further, whilst the necessary experiments are being made with a view to establishing suitable velocity standards for the various processes, the Committee recommend that:—

Smoke tests shall be applied, and no draught shall be deemed efficient which fails effectually to remove smoke generated at any point where dust originates in the course of the manufacturing process.

Extraneous dust and fresh air inlets, in conjunction with local exhaust apparatus.—The utmost regard should be paid to all sources of dust adjacent to places where processes requiring local exhaust are carried on, and suitable inlets should be provided, in positions so distributed through the room as to supply a current of fresh air flowing past the workers and towards the exhaust. These inlets are, however, a necessary part of the general ventilation, and the recommendations in regard to them will therefore be given under the next heading.

2. *General Ventilation.*

While mechanical ventilation is absolutely essential for the immediate removal of dust in special processes, the general ventilation of work places is as a whole at least equally important. On this point all classes of witnesses were entirely in accord; but both medical men and factory inspectors pointed out that, in this respect, there exists great need for improvement in nearly all potteries.

For the general ventilation of every workroom, side inlets should be provided about 6 feet from the ground, and wherever possible "hopper" openings* should be used in order that the entering stream of air may be deflected in an upward direction.

Buildings which do not lend themselves to the free introduction of fresh air should have pure air artificially supplied to them by a fan so as to secure an even distribution of such air through the room.

A suitable device for this purpose is a long straight flue, perforated along its length with apertures through which the air from a fan is delivered into the room; the flue should be placed near the ceiling, and might, with advantage, have a steam pipe within it to warm the air in winter before it enters the room. The device mentioned on page 116 and illustrated in figures 5 to 15 can also be used as a satisfactory means of distributing an incoming current of air uniformly through a room.

Cubic space in relation to ventilation.—The results of Mr. Duckering's investigation of the amount of dust in various rooms of potteries† show that, as might be anticipated, efficient provision for ensuring a flow of air through a room is much more important than the amount of cubic space per person in determining the purity of the atmosphere.

Sources of heat and moisture.—Wherever there is a source of heat it should be utilised to assist ventilation; examples of this principle have already been given in connection with drying stoves‡ and mangles,§ with regard to which recommendations have been made with the object of preventing any current of hot moist air from passing outwards into the adjoining room; in respect of workrooms, in which articles are left to dry, regulations have been suggested¶ with a view to ensuring a continuous movement of the air in the room away from the workers and towards the articles in question.

The Committee recommend the adoption of the following further regulations to deal with general ventilation in all workrooms of potteries:—

Every place in which any worker or workers are employed shall be thoroughly ventilated.

Fresh air shall be admitted to all workrooms, where practicable, by inlets placed along the sides of the room at a height of as nearly as possible six feet above the floor level; hopper openings shall be used for this purpose wherever possible.

Where it is not practicable to provide fresh air inlets in the manner prescribed in the preceding paragraph, provision shall be made for the entry of an adequate amount of pure air by a flue with openings at intervals along its length, or other means, which will secure an even distribution of the air through the room.

In no case shall fresh air inlets be so arranged that a draught can blow direct from them on to any worker.

Wherever the natural air currents are found to be insufficient without assistance to afford thorough ventilation, exhaust fans or other artificial means of creating a current of air shall be provided and maintained in use.

Where a local exhaust draught is provided for the removal of dust generated in a manufacturing process, precautions shall be taken to prevent dust being drawn into the general atmosphere of the room from other sources in the vicinity; communication with such sources shall be stopped wherever possible, and the fresh air inlets hereinbefore mentioned shall be so arranged as to ensure that no extraneous dust is drawn towards the workers by the exhaust draught.

Standards of Dust in the Atmosphere.

The tables giving the results of Mr. Duckering's tests‖ show that the quantities of dust found in places where similar processes are carried on under different conditions vary very greatly, and simultaneous observations made by him and Mr. Pendock** pointed to the fact that in the majority of instances where

* *i.e.*, openings with a deflector placed across the entering stream of air in a sloping position resembling the side of a "hopper."

† See Appendix XLIX. ‡ See page 52. § See page 74. ¶ See pages 53 and 74.

‖ See Appendix XLIX, part I. ** See Appendix XLIX, part II.

the quantity of dust was found to be great, there was some corresponding defect in the exhaust system.

The Committee have given much consideration to the question of recommending a maximum standard or standards of the amount of dust permissible in the air, but they feel that the number of cases at present determined are too few to justify them in formulating one. They hope that the improvements recommended in the construction of exhaust systems will greatly reduce the quantity, and consider that, if possible, a maximum limit, not to be exceeded, should later be fixed. To this end they advise that Factory Inspectors or some other competent observers should continue to take samples of dust systematically, and, if this is done, there should be, in a year or two, sufficient data to admit of the establishment of such standards, at any rate for certain specified rooms.

Mr. Vernon Harcourt, a member of the Committee, has designed a portable apparatus, consisting of a hand-pump with counter, and a device for filtering a known volume of air through cotton-wool, which will greatly expedite the collection of samples of dust in future, and will especially facilitate the estimation of the lead (if any) present in the air of a room. He has also worked out a method for estimating these very small quantities of lead. (See Appendix LI. and the Journal of the Chemical Society, vol. 97, p. 841.)

Temperature.

The exposure of men, engaged in drawing ovens, to very excessive temperatures has already been fully discussed,* but in addition the evidence shows that the operatives in many other departments of potteries, such as potters' shops and dipping-houses, are often called upon to work in rooms which are unduly hot. The temperature of these is, it is true, by no means so high as that frequently noted when an oven is being drawn, but it must be borne in mind that the employment of potters and dippers as well as their attendants is continuous, and in many instances the air breathed has been found to be not only hot but also moist. Such an atmosphere, according to medical witneses, conduces to rheumatism and chills, and is an incentive to lung ailments which, as already pointed out, are excessively prevalent among potters; by lowering the workers' vitality, it may also predispose them to lead poisoning.

The nature of the difficulties involved in establishing a satisfactory temperature limit, as shown by the dry-bulb thermometer, and applying it to workrooms was clearly brought out in evidence, but it was generally agreed that, in determining the wholesomeness of the atmosphere, its humidity in relation to its temperature, was of much greater importance.

In this connection careful consideration has been given to the findings of the Humidity Committee,† recently published. The problem with which they had to deal was a far more difficult one than that before the present Committee, in that the processes in humid cotton-mills involve the introduction of artificial moisture into the atmosphere of the room, whereas in potteries, if the principles of proper ventilation set forth in this report be carefully observed, there should be but little excess of atmospheric moisture within the workroom itself. The present Committee therefore recommend a maximum wet-bulb standard of 70° F., which, although five degrees less than that proposed by the Humidity Committee, will probably, in potteries, be quite easy to observe. On certain days in the summer, which are excessively hot and moist, some exception would no doubt be needed, and it is suggested that the limit of 70° F. wet-bulb should be suspended at any time, when the reading of the wet-bulb in the shade outside the factory exceeds 65° F. This will probably be a rare occurrence, as the meteorological tables show that such a moist temperature is seldom reached in Great Britain, and has only been recorded by the self-registering instruments of the Meteorological Society on the following occasions during 1908:—

	No. of days.	Dates.
At Aberdeen - - -	1	Oct. 3rd.
" Kew - - - -	27	May 31st; June 1st–4th, 10th, 26th, 29th, 30th; July 2nd, 3rd, 22nd–26th, 30th; August 3rd, 4th; Sept. 20th, 28th–30th; Oct. 1st–4th.
" Falmouth - - -	0	

On the one day at Aberdeen, and on six of the 27 days at Kew, the high wet-bulb temperature only lasted for one hour.

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* See pages 58 and 59.

† See Report of the Departmental Committee on Humidity and Ventilation in Cotton-Weaving Sheds, Cd. 4484, 1909.

In the recent special rules for earthenware and china, 1898 to 1903, no temperature limit has been included; but those for 1894, which are still in force in 43 potteries, provide that the temperature shall not at any time exceed 90° F., dry bulb. This rule, doubtless because of its unsatisfactory character, was omitted when the subsequent codes of 1898, 1901 and 1903 were drafted; but the Committee, in advocating a wet-bulb in place of a dry-bulb standard, feel that they are justified in recommending the application, to all workrooms in all potteries, of the regulation suggested on page 53 for limiting the temperature of potters' shops.

Thermometers.—Several witnesses pointed out the need for having thermometers provided in certain departments of potteries, notably those in which drying is done, or in connection with which artificial heat is used in aid of the manufacturing process. The Committee accordingly recommend that:—

> A thermometer, suitably mounted for observing the wet-bulb reading, shall be provided in every workroom in which any articles are allowed to dry, or in connection with which artificial heat is used in aid of the manufacturing process, whether in the workroom itself or in drying stoves or mangles or other appliances adjoining the workroom.

Steam Pipes, etc.—Reference was also made, in evidence, to some complaints in regard to the heat radiating from uncovered steam pipes passing through workrooms; the Committee suggest a regulation in the following terms:—

> Wherever steam or hot water pipes pass through a workroom they shall be efficiently protected, and if not used for the purpose of heating that room, they shall be efficiently covered with non-conducting material.

Hours of Employment.

Lead Workers.—Much evidence was given before the Committee to the effect that long hours are conducive to plumbism, and it was urged that a reduction should be made in those during which it is permissible for lead workers to be employed.

Factory Inspectors quoted, as precedents, similar restrictions in other dangerous trades,* and two operatives gave particulars as to the excessive spells which they had worked before being laid aside with an attack of lead poisoning. The general trend of the evidence of medical men, inspectors and operatives was in favour of limiting the work of males and females generally to eight hours a day, or forty-eight hours a week; for women and young persons engaged in the most dangerous processes, viz., those of the dipping house, the day's work, they considered, should be restricted to six or seven hours, but admitted a slightly longer period of labour as reasonable in the case of glost placers.

Leading manufacturers stated that they would accept a 48-hour week for women and young persons in all scheduled lead processes, and one of them added that this limitation had already been introduced, for men as well as women, in three out of the five principal china furniture factories. On the other hand, the other manufacturers' witnesses were strongly opposed to any limitation of hours in the case of adult men.

The Committee have discussed this matter in all its bearings, and have taken careful note of hours actually worked in the various departments of certain factories. As a result they have come to the conclusion that for all women and young persons employed in scheduled lead processes, a week of 46 hours could quite easily be enforced without risk of injury to the trade; in like manner the week's work for adult male workers similarly employed could, as a rule, be limited to 48 hours, but in their case it would be necessary to permit certain exceptions to be made. Glost placers, for example, are accustomed, under ordinary conditions, to work rather longer hours than other pottery lead workers, and seeing that they are, in addition, exposed to a lesser degree of risk, the limit of the week's work could in their case well be extended to 54 hours.

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* Rule 2 of the Special Rules for Vulcanising of India Rubber by means of Bisulphide of Carbon.
Rule 2, dealing with flue cleaning, in the Special Rules for Lead Smelting.
Rule 7 of the Special Rules for the Manufacture of White Lead.

Further, in respect of all adult male lead workers whose weekly period of work it is proposed to restrict, provision should be made against the amount of overtime employment in any factory exceeding four hours in any one week, or 36 hours during any period of twelve months; regulations should also be made embodying conditions similar to those applying to the overtime employment of women under Section 49 of the Factory and Workshop Act, 1901; and in addition all occupiers who desire to employ men overtime in any of the processes in question, should be required to produce evidence of either an abnormal press of orders or other circumstance necessitating an extension of the working hours.

The Committee, therefore, recommend the following regulations:—

1. Women and young persons in any scheduled lead process shall not be employed more than 46 hours per week.

2. Adult male dippers, dippers' assistants and ware cleaners, shall not be employed more than 48 hours per week.

3. Adult male glost placers shall not be employed more than 54 hours per week.

4. It shall be permissible to employ adult male dippers, dippers' assistants, ware cleaners, and glost placers overtime, in addition to the prescribed weekly periods of 48 and 54 hours; provided that such overtime employment shall not take place in any factory for more than 4 hours in any one week, or 36 hours in any period of twelve months. The occupier shall enter in the prescribed register particulars of all such overtime, and shall also send notice with the prescribed particulars, to the Factory Inspector for the district, before eight o'clock in the evening on any day when a man is employed overtime in pursuance of this exception.

An occupier who avails himself of this exception shall, if called upon, produce to the Factory Inspector evidence of press of orders or other circumstance rendering the overtime necessary.

Hours of work in dusty processes not involving contact with lead.—The evidence, while dealing primarily with the ill-effects of excessive hours in the case of lead workers, also clearly shows that the evils arising from the breathing of flint and other dusts are so serious that every endeavour ought to be made to limit the period of daily exposure to them.

At the same time the Committee hope their other suggestions will lead to a very material improvement in the conditions of labour in the potteries, and therefore they only advocate an extremely moderate reduction in the hours, viz.:—

In potters' shops, including tile-making shops, and in any other non-lead process admittedly dusty, no woman or young person shall be employed for more than $9\frac{1}{2}$ hours in any day, exclusive of meal times; or, in other words, 11 hours inclusive of $1\frac{1}{2}$ hours for meals. On Saturdays, no woman or young person shall be employed for more than $6\frac{1}{2}$ hours exclusive of meal-times.

Continuous spell of work.—Several witnesses pointed out that five hours without a break, as permitted by the present Factory Act, is too long a period of continuous employment in pottery processes, and shorter spells varying from $3\frac{1}{2}$ to $4\frac{1}{2}$ hours were suggested. Witnesses, speaking for the manufacturers, stated that they saw no objection to limiting continuous work to four hours at the most. The Committee think this will prove most advantageous, and recommend a regulation to the effect that:—

No person shall be employed for more than four hours without an interval of at least half an hour for a meal; provided that this regulation shall not apply to adult males employed as engineers, firemen, millers, or as attendants of such workers.

Holidays.—Some evidence was given calling attention to the value of holidays in securing such a general condition of good health as will reduce the risk of employment in a dangerous process. The Committee desire to call attention to this, but do not think it necessary to recommend a special rule to deal with it considering the general customs of the trade, which already make a sufficient provision for holidays.

Alternation of Employment.

The great advantages of giving, to every lead worker, a period of work in a non-dangerous process, was clearly brought out in the evidence of medical men, inspectors, employers and operatives alike; examples of the effective working of such a system were given, one of the most instructive being that outlined by Mr. Wedgwood.*

At the same time, there are admitted difficulties in the way of introducing this method into many factories; the Committee do not, therefore, feel that it would be practicable to frame a regulation to enforce its adoption; but the attention of manufacturers should be called to the desirability of introducing it wherever possible, as it cannot fail to prove beneficial.

Floors.

The important subject of providing suitable floors, which can be kept properly clean, has been fully dealt with in relation to those processes in which the danger arising from ill-kept floors is most serious, but those of other workrooms in potteries† also need some consideration. All workrooms, even where no process specially regarded as dangerous is carried on, are subject to the present rule requiring daily sprinkling and sweeping, but the trend of the evidence was opposed to dry or semi-dry sweeping, and it was agreed that cleaning by some moist process should be substituted wherever possible. It is also regarded as essential that the floors should be maintained in such repair as to admit of a thorough cleaning, by a moist method. The provision, on the other hand, that the daily cleaning should be done by an adult male need not be extended to processes other than those already dealt with.

The Committee, therefore, recommend that the following regulations should be made applicable in work places other than those with regard to the floors of which specific suggestions have been already made:—

All floors shall be mended and maintained in such repair that they can be thoroughly cleaned by a moist method, and shall be so cleaned daily.

All ashes, dirt or other débris, including any which have accumulated under benches, shall be carried out daily.

Clothing of Women in Dipping Houses, etc.—Mention was made in evidence of the evils arising from the wearing of unsound boots in dipping houses and other similar places; and attention was also called to long trailing skirts as a source of danger by reason of their tendency to raise dust from the floor. The Committee consider it very desirable that all skirts should be at least six inches clear of the ground, and they think the workers' attention should be called to this, as well as to the necessity, in the interests of their own health, of wearing substantial boots or shoes. They do not, however, regard either of these matters as being of a nature which can properly be dealt with by special regulations officially issued by the Home Office.

Sanitary Conveniences.

A considerable amount of evidence was tendered to the Committee dealing with the insanitary condition of the closets provided for workpeople at many factories. Several medical men stated that this might easily exercise a prejudicial effect on the health of the operatives. It was explained that, in all North Staffordshire pottery towns at least, Section 22 of the Public Health Acts Amendment Act, 1890, has been adopted by the Local Authority, and therefore, in the normal course, a factory inspector does not take action in regard to unsatisfactory sanitary accommodation, but reports the defects noted to the Local Council, who take such action as may be necessary to bring the accommodation up to their own standard. Much of the trouble arises from the various towns setting up widely different standards of what is requisite in this respect, the demands of some authorities being, according to the evidence, inadequate to secure decent conditions. The Committee strongly

* See Appendix XXXVIII.

† Including the glazing departments of potteries which are recommended for exemptions in consideration of the exclusive use therein of leadless or low solubility glazes.

recommend that ordinary water-closets or the best types of trough closets with rim flushes should be adopted wherever there is a proper sewer and water supply; where no such provision exists, properly designed earth closets should be provided, and the regular periodical emptying thereof at short intervals strictly enforced.

This recommendation should be brought to the notice of all Local Authorities whose area contains potteries; but it is clearly not a matter for inclusion in proposed Regulations under Section 79 of the Factory Act, 1901.

STONE WARE AND COARSE WARE FACTORIES.

This class of potteries has already been briefly referred to on page 7 of this Report.

Dr. Whitelegge, H.M. Chief Inspector of Factories, explained in his evidence that service of the various codes of rules, from 1894 to 1903 inclusive, had been withheld from most of these works, in order that they might be suitably dealt with at the time of the complete revision of the Pottery Rules, which has been entrusted to the present Committee. When, however, the new code is issued in the form of Regulations, it will not be possible for the Home Office to adopt a similar course, because in virtue of Section 79 of the Factory Act, 1901, regulations are automatically in force wherever the processes dealt with are carried on. It is therefore necessary for the Committee to recommend such modifications as appear to be called for, in order that they may be inserted in a special clause of the regulations themselves. The Committee accordingly included certain stone ware factories in their visits and also heard evidence from stone ware manufacturers.* It was claimed by one of these witnesses that there was no record of illness attributable to work in stone ware potteries; but the work is at least as dusty as that in the potters' shops of ordinary earthenware and china works, and the Committee feel that they must be guided largely by the opinion of Sir Thomas Oliver and others, who hold that the continuous breathing of any such dust cannot fail in many cases to lead to lung trouble. It should also be borne in mind that coarse ware factories are generally to be found singly, or two or three together, in large industrial centres, where the workers affected by the dust would not be noticed, among the thousands of operatives engaged in other industries.

The Committee therefore recommend that:—

The proposals which they have made with regard to all processes other than those in which glazes or dipped ware are handled, shall also be enforced in coarse ware and stone ware factories, in respect of all processes carried on therein which are similar in character and involve like risks.

Where no lead is used in the glaze, the glaze processes shall be subject only to those regulations which are applicable to ordinary earthenware and china works where leadless glaze is exclusively used.

Where glazes conforming to the 5 per cent. solubility standard, or made of galena, are exclusively used, the glaze processes shall be subject only to those regulations which are applicable to similar glazes in earthenware and china works.

Where glazes are used other than leadless glazes, galena, or lead glazes of solubility not exceeding 5 per cent., the full code of regulations shall apply as in ordinary earthenware and china works.

RECOMMENDATIONS REGARDING ADMINISTRATION.

INQUESTS.

An inquest is usually held on every fatal case of industrial lead poisoning, and Dr. Whitelegge in his evidence informed the Committee that, by a circular issued in 1898, the attention of coroners was drawn to the importance of the practice. There is, however, a feeling that at such inquests the operatives have not always been fully represented, and their witnesses asked for the adoption of a clause confirming

* See evidence of Mr. Kennedy, Questions 14320–504, and Mr. Service, Questions 14505–530.

the right, which is as a rule freely granted by coroners, of a workers' representative to attend.

The Committee consider this to be quite a fair request, and recommend that:—

At every inquest on a lead worker, a representative of the workers shall be given the same facilities for questioning witnesses as is allowed to the employers' representative.

Post Mortem Examinations.—In connection with the Inquests above-mentioned, it is usual for the Coroner to order a post mortem examination to be made; much technical evidence was given regarding the conclusions which can be safely drawn from an autopsy in cases of suspected lead poisoning, and witnesses representing the workers put forward sundry suggestions with a view to ensuring the conduct of post mortem examinations by medical men who would approach the subject with an entirely unbiassed mind.

The Committee, however, do not think that they are in a position to suggest rules for the guidance of the legal authority who selects the medical man to make the examination of the body; they prefer, therefore, to recommend the following provision for ensuring that all interests shall be fully represented:—

Whoever conducts the post mortem examination, the relatives of the deceased, or failing them the trade union of which the deceased was a member shall have the right to nominate an additional medical man to attend the post mortem examination and to be present at the inquest.

If this recommendation be acted upon, it will doubtless become general for four persons to be present at the autopsy, namely:—

(1) the medical man conducting the post mortem;
(2) a medical man representing the employer or his association;
(3) a medical man representing the deceased's relatives, or his union;
(4) the Certifying Surgeon.

ENFORCEMENT OF REGULATIONS.

Inspection Staff.

Up to 1898 the inspection of the district of North Staffordshire was carried out by one inspector single-handed. In that year a second was appointed, both being stationed at Stoke-on-Trent, and in 1908 an assistant was added whose duty it is, to some extent, to take charge of less important places, such as workshops, leaving the inspectors free to devote more time to the inspection of potteries and other large factories. In recent years also a great part of the time of one lady inspector has been spent on pottery work.

Work of Inspectors.

It will be remembered that in North Staffordshire there are of potteries alone as many as 329, and in addition there are some 170 factories of other dangerous trades, making an approximate total of 500 which the Inspection Staff are instructed to visit four times a year. There are, besides, upwards of 1,700 factories of trades not classified as dangerous, to each of which one visit a year is expected to be made, so that the total number of visits to be paid annually to factories in this district amounts to 3,700. These visits, moreover, do not constitute the whole of the inspectors' work; they have also from time to time complaints and accidents to investigate, inquests to attend, and prosecutions for breaches of the Factory Acts and Truck Acts to conduct; after allowing for these special calls upon their time, as well as for holidays, it is estimated that there are only about 180 working days available for each inspector to devote to routine inspection, and if, therefore, all the 3,700 visits are to be paid, many of them must be of a very hurried character.*

* Analyses of the work of inspection of earthenware and china works and lithographic transfer factories in the North Staffordshire district will be found in Appendix XIX.; particulars are there given for 332 potteries at work at the end of October, 1908, of which three were closed before the end of the year. In Appendices XX. and XXI. will also be found particulars of the prosecutions and written notices to occupiers concerning irregularities noted in connection with earthenware and china special rules in the North Staffordshire district.

Insufficiency of the System.

The Committee have heard from all sides of the zeal and ability with which the Factory Inspectors perform their duties, and have formed a high opinion, from their own personal knowledge, of the work of the inspectorate, believing, indeed, that there are no public servants who give better value, in respect of accomplished work; it is, however, evident from the results of the present inquiry, that the 360 days' routine inspection by the two resident inspectors, even though supplemented in recent years by a great part of the time of one lady inspector, has proved quite insufficient to ensure a thorough and continuous observance of the prescribed precautions in all the factories of the North Staffordshire district. Similar considerations apply with even greater force to the inspection of potteries outside the North Staffordshire area, and it must further be borne in mind that in the smaller pottery centres, such as those in Scotland and the North of England, the manufacture of earthenware and china is by no means the most important local industry, and therefore the inspectors resident there have not the same opportunities as those who inspect North Staffordshire factories for acquiring an expert knowledge of all the sources of possible danger to be looked for when visiting a pottery.

Whether owing to insufficient inspection or other causes, there are many factories in which none of the codes of rules, from those of 1894 to those of 1903 inclusive, have been fully observed, and some manufacturers have constantly been able to break the laws for long periods with absolute impunity. To overcome these evils, several witnesses advocated the appointment of more inspectors, and the Committee consider that some permanent augmentation of the staff in the North Staffordshire district is certainly needed. But apart from this, if a new code of regulations is issued on the recommendations of this report, it will of itself necessitate a considerable increase; in order to secure a thorough observance of its structural requirements and the proper installation of the new system which it embodies or the improvement of those in existence, it will be essential, for at least a year after it comes into operation, to have the various potteries frequently visited, and it would be most impolitic if, for this purpose, the ordinary work of inspection was suspended or reduced by detaching inspectors from their routine duties. It therefore seems desirable that the available staff should be strengthened by the appointment of at least two or three special inspectors, to be told off as and when required for temporary service, wherever the excessive pressure of work might call for their assistance. In addition, the Committee consider that in districts outside North Staffordshire the inspectors in charge should be helped by providing that all earthenware and china works located within their areas, shall, once a year, be visited by a special inspector whose acquaintance with all the details of pottery inspection has been long and intimate.

But even this would fail to ensure the continuous attention to the regulations in every pottery essential to a satisfactory system. By such a strengthening of the staff a visit might well be secured to each earthenware and china works every two months instead of quarterly, and sufficient time be devoted to each visit to render the inspection thorough in every detail. But an interval of two months would still allow ample opportunity for the development of carelessness and indifference on the part both of employers and employed. Even if expense were no object, and it were consequently practicable again to double the staff, it would only double the frequency of the inspection without altering its character, and serious evils could equally well result from neglect of precautions during the monthly interval.

The Committee, think, therefore, that before increasing the staff to a greater extent than that just recommended, an effort should be made to supplement the work of the inspectors by an entirely different method.

Need of Constant Inspection by Occupiers Themselves.

When it is considered that lead poisoning, serious as it is, is by no means so wide-spread an evil as the excessive lung disease which arises from conditions of labour unconnected with the use of lead, such as the working in dusty, hot, and moist rooms, the situation becomes the more deplorable; unfortunately the Committee cannot hope that, if the new rules they propose are adopted, they will be any more effective than previous codes, unless they are much more carefully observed, and for the attainment of this object at the present moment there is in most factories

little or no organisation. When in 1901 and 1903 the manufacturers promised Lord James of Hereford, through their Counsel, Mr. Fletcher Moulton, that lead poisoning should be practically extirpated, it was with the proviso that the observance of rules would depend on the activity of the Home Office; by this they were understood to mean that, while they undertook to carry out such rules, it rested with the inspectors to see that they did so; but a wider interpretation has since been given to the reservation, and some apparently rely entirely on the inspectors to insist on the necessary arrangements being made in their factories, instead of personally doing so themselves.

Methods proposed for a new System of Supervision.

To ensure satisfactory compliance with the new rules it is essential that every department of every factory should be under constant and regular observation, and to attain to such complete supervision it is equally essential that it should be organised from within the factories themselves. The Committee are, in consequence, strongly of opinion that all occupiers should be made to realise their responsibility in this respect, and be required personally to institute such a system.

Constitution and Powers of Proposed Advisory Board.

For this purpose it was at first proposed that a standing Advisory Board should be appointed by the Secretary of State, to which it should be incumbent on the occupier to make periodical reports at short intervals. The Board, it was suggested, should consist of an independent Chairman representing the Home Office, and a small but equal number of employers' and workers' representatives connected with the leading sections of the trade, such as china, earthenware, tiles, and sanitary ware. Its powers were to be strictly limited, and the greatest care to be exercised in drawing up the standing orders for its regulation, so as to preclude any possibility of its interfering with the authority of factory inspectors, or in any way impairing their usefulness. In character it was to be solely advisory; it was, so to speak, to be in the position of an overseer ready to receive the periodical reports of manufacturers, or to give an opinion on any point of difficulty that might be conveniently referred to it; to draw the attention of the manufacturer to any breach of special regulations which might be brought to its notice, and to tender him such advice or assistance as might better enable him to secure their proper observance; it was also intended that its object should be to see that the regulations as applied to special classes of work were reasonable; if some enactment were pressing too heavily on a particular department, if some new process were introduced which was not contemplated in the rules, or if improved methods were invented which justified their relaxation, the Board was to have been in a position to report to the Home Office, recommending such modifications as might appear to be necessary; but it was to have had no executive authority; it was to have been bound to report to the Chief Inspector of Factories the results of its deliberations on any matters concerning the regulations or their administration, and if a manufacturer failed to send in his reports, or omitted to remedy defects which had been properly brought to their notice, it was to have been the duty of the Board to report the matter to the local inspector, with whom alone it would have rested to take any legal action which might be desirable.

Objections to the Proposed Board.

Much careful consideration was given by the Committee to this proposal, and the Chairman, accompanied by Mr. William Burton and Mr. Bernard Moore, attended a meeting of the Joint Committee of Manufacturers' Associations at Stoke-on-Trent on 27th January, 1910, for the purpose of discussing it. The manufacturers, however, greatly to the regret of the majority of the present Committee, were unable to co-operate in the inauguration of such an Advisory Board for the pottery trade; the Joint Committee of Manufacturers' Associations, while representing most of the large firms, and including employers of about two-thirds of all the pottery operatives in the United Kingdom, as a matter of fact only embraces less than one-third of the firms under earthenware and china special rules; again, the pottery operatives who are members of trades unions form only a small minority of the total numbers employed in the industry, and in coming to their decision the manufacturers may have been influenced by the probability that the want of organisation among both employers and employed would render it difficult to select representative men to serve on the proposed Advisory Board.

Alternative Scheme of Supervision recommended.

The Committee have accordingly discussed various alternative schemes whereby a constant attention to the prescribed precautions might be secured, and they recommend that regulations should be established on the following lines:—

1. There shall be affixed in every potters' shop and in every place in which any process included in the Schedule* is carried on, a notice printed in bold type so that it can be easily read, setting forth those portions of the regulations which apply to that particular workplace.

2. In every factory the occupier shall appoint a person, or persons, who shall see to the observance of the regulations and shall record in a register weekly the prescribed details in regard to prescribed questions, as follows:—

(1) Floors.—Have these been, during the past week, cleaned daily by the prescribed methods and within the prescribed time?
(2) Work benches.—Have these been, during the past week, cleaned daily by the prescribed methods and within the prescribed time?
(3) Mess-rooms.—Have these been cleaned regularly?
(4) Lavatories.—Have clean towels been supplied daily, and soap and nailbrushes been kept available as prescribed?
(5) Exhaust draughts.—Have these been observed and found to be in adequate order, as regards rate of entry of air into hoods, cleanliness of fan, efficient working of belts, freedom of ducts from refuse or other obstruction, and in other respects?
(6) Thermometers.—Have these been read and in no case found to exceed 70° F., wet-bulb?
(7) Boards for newly-dipped ware.—Have none but clean boards been used for this purpose?
(8) Overalls and head-coverings.—Have the rules regarding these been fully observed?
(9) Has careful examination been made into the observance of the other regulations in force, and have they been found to be fully observed, so far as could be ascertained?

3. Copies of the prescribed questions and the weekly entries shall be published each week by affixing them in a prominent place in the factory as well as in the mess-rooms.

If the proposed method of self-inspection be made compulsory under the regulations, any failure to make the necessary observations and record the results in the prescribed form, would constitute a breach of the regulations, and therefore entail a penalty, on conviction, not exceeding £10, in accordance with Section 85 of the Factory and Workshop Act, 1901. On the other hand, a deliberately false entry would render the person making it liable to conviction under Section 139 of the same Act, which provides that the penalty for forgery of certificates, false entries or false declarations shall be a fine not exceeding £20 or imprisonment for a term not exceeding three months, with or without hard labour.

Such a system of internal supervision, if strictly enforced, will ensure continuous attention being paid, in every factory, to the due observance of the regulations, and the information so required will be at the constant disposal of the inspectors. By this means the Committee believe that the inspection will be made more thorough without that great increase of the staff which, to obtain similar efficiency, would otherwise be essential. On the other hand, the system must be in its early stages largely experimental, and it is impossible to forecast with any exactitude the extent to which the inspectors' work will be actually affected. It is probable that in respect of routine inspection it will be considerably lightened, but if the operatives take a lively interest in the protective measures which the scheme provides, it may be considerably increased. There may be more complaints requiring prompt official investigation, many even necessitating prosecution, and it might well transpire that, to cope successfully with the additional work, some enlargement of the staff would be requisite.

* The list of dangerous processes, both lead and non-lead, see p. 97.

CONCLUSION.

Specimen codes, intended merely as a suggestion of the manner in which the Committee's recommendations could be formulated into draft regulations for the better conduct of the pottery trade, are given on pages 131 onwards, immediately following this Report. Many of the Committee's conclusions have reference to the administration of the regulations, and these will doubtless be taken into consideration in the drafting of fresh instructions to certifying surgeons and others. It is needless further to impress on employers the importance of seeing that the various provisions, if adopted, are properly observed; but it is desirable to point out to the operatives the duties which in this respect devolve on them: the various precautions devised are entirely for their benefit, but any wide-spread neglect or indifference on their part cannot fail to defeat the object in view.

That the regulations proposed are stringent there is no doubt, and it is obvious that the much-needed reforms cannot be introduced without considerable expense, which may appreciably raise the cost of production of pottery in this country. The manufacturers' representatives on the Committee accordingly, while welcoming every suggestion which will make for the improved health of the workers, feel strongly that they are unduly handicapped by the importation of pottery from places abroad, where the same high standard of working conditions is not enforced. How to meet this difficulty it is not within the province of this Committee to inquire; it is obviously impossible to trace every imported article back to its source of origin, and so ascertain the circumstances of its production; it is, however, to be noted that in several countries stringent regulations, applicable to potteries, have already been introduced, whilst in others such legislation is under consideration.

Before closing this Report, the Committee wish to record their appreciation of the fair and reasonable manner in which the Factory Department have enforced the provisions of the Special Rules for the Manufacture of Earthenware and China in the past, and to express a hope that the regulations now recommended will, if adopted, be put into operation with the same steadfast desire to secure compliance with the true spirit of their requirements. Some of the specific regulations proposed may not be universally practicable owing to the varying conditions of manufacture; if, therefore, at any time it is shown to the satisfaction of the Secretary of State in the case of any manufacture or process, or any operation forming part thereof, that injury to health is adequately prevented by other appliances or under other conditions than those prescribed by the Regulations, the Secretary of State should reserve power, by Order, to modify the whole or any part of the Regulations so far as they apply to such manufacture or process.

In connection with the technical side of the inquiry, the Committee wish to record their appreciation of the valuable work done by Mr. Pendock and Mr. Duckering in the course of their detailed investigations on behalf of the Committee concerning the methods of ventilation and the amounts of dust in the atmosphere of various rooms in potteries.

In conclusion, the Committee desire to express their most sincere thanks to Mr. Werner for the great assistance which he has rendered them in the course of their inquiry and deliberations. The whole question has been one replete with difficulties and complications, and his assiduity, ability, and, above all, his knowledge of the subject, have been of the utmost service.

We have the honour to be, Sir,

Your obedient Servants,

ERNEST F. G. HATCH, *Chairman.*
WILLIAM BURTON.
NOEL BUXTON.
THOMAS EDWARDS.
BERNARD MOORE.
NOAH PARKES.
GEO. REID.
A. VERNON HARCOURT.
JOHN WARD.

EDMUND A. R. WERNER,
Secretary.

MEMORANDUM BY MISS TUCKWELL.

It is with deep regret that I find myself unable to sign the Report of my colleagues. The Committee were appointed primarily to enquire into the dangers attendant on the use of lead, as may be seen from the order of the Terms of Reference, and, however much I concur in many of their admirable recommendations, I find these inadequate so far as the use of lead is concerned.

I wish to emphasize my support of the precautions recommended by the Committee for dealing with diseases of the lungs, their suggestions as to structural improvements, reduction of the hours of labour, raising of the age of employment, and above all their general recommendations as to the necessity for compensation in all cases of "suspension," as well as during the enforced absence of women from work at the time of child-birth. I must, however, add that I deprecate any vagueness of wording which may lead to the impression that any scheme of contributory insurance involving an additional tax on women workers is possible; and in regard to the proposed limitation of the men's hours in certain lead processes (see page 121), while the proposal is in itself excellent, I should feel it my duty to enter an emphatic protest against the suggested introduction of legalized overtime employment for men, were it not that I regard myself primarily as representing women's interests on the Committee.

The Use of Lead.

The dangers attendant on the use of lead peculiarly affect the question which led to my presence on the Committee—the health of women workers in the dangerous processes. The lead poisoning attack rates for all persons employed in scheduled lead processes in potteries (see Appendix VII., General Table, as quoted on page 96 of the Majority Report), were:—

in 1908, 26 per thousand among females as compared with 12 per thousand among males;

and in 1909, 13 per thousand among females as compared with 6 per thousand among males (numbers employed: males, 4,504; females, 2,361).

If we examine the Sectional Tables, we find that, for dippers' assistants (see Appendix VII., Sectional Table C, quoted on page 70 of the Majority Report), the attack rates were:—

in 1908, 48 per thousand among females as compared with 13 per thousand among males;

and in 1909, 23 per thousand among females as compared with 2 per thousand among males (numbers employed: males, 463; females, 397).

Among ware cleaners the corresponding figures (see Appendix VII., Sectional Table D, quoted on page 75 of the Majority Report) were:—

in 1908, 43 per thousand among females as compared with 17 per thousand among males;

and in 1909, 28 per thousand among females, while there were no cases among males (numbers employed: males, 115; females, 461).

These statistics point to a general attack rate among women at least double that among men, with a very much greater disproportion in the case of the most dangerous lead processes.

For medical evidence as to general deterioration of health, and as to the effect of lead upon women during pregnancy and child-birth, I have only to refer to the admirable statement of evidence contained in the Majority Report.

The operatives recommended to the Committee that no women should in future be engaged for employment in any dangerous process in those factories where the standard of 5 per cent. solubility was exceeded. I should have had to concur in this proposal, in spite of the fact that much hardship would thus have been caused in a district of one trade, such as the Potteries, had it not been that a definite alternative exists by imposing limitations on the use of the material, instead of on the classes of workers.

My colleagues propose to deal with this question by strengthening of rules, improvement of ventilation, and the introduction in potteries of a "scheme of supervision by inspection of factories from within."

Many of these recommendations are admirable in themselves, but I take exception to the proposal for the scheme of supervision. By this, importance is attached to the signature of a representative of the employer to lists of questions

as to compliance with the rules. Such a system hampers inspection, if the system itself does not become a dead letter. I therefore desire to urge a very considerable increase in the staff of H.M. Inspectors, in preference to any attempt to secure "self-inspection" in factories.

The 1901-3 Special Rules, which were, in the language of the manufacturers' counsel, "to extirpate lead poisoning," have already been tried, and have failed in this object: embodied in the Majority Report (see page 126) is a suggestion to set up an Advisory Board, but in this connection it is significant that a special committee of manufacturers, acting under the able chairmanship of Mr. William Burton, has, according to the evidence of the late Superintending Inspector, Mr. Redgrave, "had very little influence at all with the rest of the trade."

Effect should also be given to the recommendations as to the closing of those Potteries which cannot be made fit for use owing to their bad structural arrangements or dilapidated condition, which were made in 1893 by the medical members of the Potteries Committee of that year*, and have been emphasised on several subsequent occasions, notably by Dr. Thorpe and Dr. Oliver in their Report of 1899, page 15.

Low Solubility.

Further proposals appear to me essential. The strong recommendations made by Dr. Whitelegge, H.M. Chief Inspector of Factories, that definite and adequate inducements be held out to manufacturers to limit the use of lead is emphasized by the Report of my colleagues, who urge "that every inducement and encouragement should "be given to the manufacturers both to persevere with their experiments in search of "satisfactory leadless and low solubility glazes, and to introduce them whenever "possible." To give force to these recommendations, I suggest the development of the policy laid down by Lord James's award, under which the compensation of the workers was made an alternative to the use of a glaze of under the 5 per cent. standard. By the Workmen's Compensation Act it is now incumbent on manufacturers to pay compensation at a rate based on half the wage previously earned. I propose that adhesion to a scheme of insurance by which the workers who suffer should be compensated to the full extent of their previous earnings should be a condition of the permission to use a glaze exceeding the 5 per cent. standard.

Leadless Glaze.

But though, in view of the strong evidence laid before us as to the value of encouraging a low standard of solubility, development of the compensation scheme is desirable, in face of the evidence and of the figures given as to suffering, it is necessary to insist that, as long as lead is used, lead poisoning will not be stamped out. The evidence of Dr. Legge, H.M. Medical Inspector of Factories, supported by Dr. Hill, Certifying Surgeon, and others, was to the effect that the most perfect application of mechanical means, for the removal of dust and other purposes, would only permanently reduce the cases of lead poisoning by half.

It was at first the opinion of my colleagues that there should be compiled a Schedule of Articles to be made only with leadless glazes, to which the Home Office should have power to add. To this recommendation I adhere. A gradual extension of this Schedule could be developed as the Home Office saw fit, till within a given number of years the use of lead in the manufacture of china and earthenware should be abandoned. I would add the suggestion that as a condition of the use of lead in colours, some limitation of the amount so used should be considered by the Home Office.

The policy of prohibiting the importation into this country of articles manufactured with lead glaze, wherever the manufacture of such articles in this country has been forbidden, is a sound one. The Yellow Phosphorus Act forms a valuable precedent for this policy. In the first instance, however, the prohibition of importation would be immaterial, since the goods scheduled would be those of a simple class which can at present be produced at least as well in leadless glaze as in leaded glaze, and also more cheaply.

Government Departments.

I also recommend the development of the policy admirably carried out at present by the Office of Works. It should be made imperative on Government Departments to ask for tenders only for Leadless Glazed Ware.

GERTRUDE M. TUCKWELL.

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* See Report of Potteries Committee, 1893, page 8.

PROPOSED CODES OF REGULATIONS EMBODYING RECOMMENDATIONS OF COMMITTEE.

It will be convenient, as stated on page 128, to append specimen of regulations showing clearly how the enactments retained from the Special Rules of 1903 at present in force might be embodied with the new provisions suggested by the present Committee.

SPECIMEN CODES.

To facilitate reference to the Special Rules of 1903 at present in force, the provisions thereof, which are retained, are shown in bold type, and the additional words and clauses, recommended by the present Committee, in ordinary type.

PROPOSED REGULATIONS

Under Section 79 of the Factory and Workshop Act, 1901,

For the Manufacture and Decoration of Earthenware and China, and the Manufacture of Lithographic Transfers for Pottery.*

Definitions.

In these regulations: —

"The solubility" of a glaze or other material containing lead shall be deemed not to exceed 5 per cent. if the dried glaze yields to a dilute solution of hydrochloric acid not more than 5 per cent. of its dry weight of a soluble lead compound calculated as lead monoxide when determined in the following manner: —

> A weighed quantity of dried material is to be continuously shaken for one hour, at the common temperature, with 1,000 times its weight of an aqueous solution of hydrochloric acid containing 0·25 per cent. of HCl. This solution is thereafter to be allowed to stand for one hour, and to be passed through a filter. The lead salt contained in an aliquot portion of the clear filtrate is then to be precipitated as lead sulphide, and weighed as lead sulphate.

"Surgeon" means the **Certifying Factory Surgeon of the District**, who **shall have**, as regards all persons examined by him in pursuance of these regulations, **power of suspension** and of permission to work, by certificate which may either be entered in the health register by the Surgeon personally, or be sent by him to the occupier.

"Entered in the health register" means:

(*a*) Entered in the prescribed register kept at the factory in pursuance of Regulation 3; or

(*b*) Entered in the portable register prescribed for the use of casual workers.

"Suspension" means suspension, by signed certificate of the Surgeon, from employment in any process in which examination by the Surgeon is required by these regulations.

* It is suggested that modified codes should also be issued embodying the exemptions recommended for potteries using exclusively leadless and low solubility glazes; and further, that, as far as possible, the occupiers of factories in which only certain of the processes of pottery manufacture are carried on, should be furnished with simplified regulations containing only such provisions as apply to the operations conducted in their works. Such a code, suitable for factories in which only lithographic transfers are made, is given on page 145.

"Permission to work" means permission, by signed certificate of the Surgeon, either:

(*a*) Terminating a suspension, or

(*b*) Permitting employment of a certain specified kind.

"Potters' shops" includes any place where tiles or other articles are made by pressing clay dust, as well as every place where articles of pottery are shaped by a plastic or other process.

"Wedging of clay" means the treatment of clay which has not been pugged or rolled, by raising one piece of clay by hand and bringing it down upon another piece; but does not include the process, frequently known as "slapping of clay," in which two pieces of clay each small enough to be held in one hand are slapped together.

"Workroom" shall not, for the purposes of Regulation 10, include any stove or drying chamber which is not entered by workers except for the purpose of carrying ware in or out or turning it.

"Bedding" means the placing of flat ware in powdered flint for the biscuit firing when the sagger or box containing the ware is filled up with powdered flint.

"Flinting" means the placing of flat ware in powdered flint for the biscuit firing when the sagger or box containing the ware is not filled up with powdered flint.

"Scouring" includes fine brushing, as well as sandpapering, brushing, and every other scouring process, as applied to biscuit ware.

"Stopping of biscuit ware" means the filling up of cracks in ware which has been fired once and before glaze is applied to it.

"Glost placing" includes the operations of carrying saggers of ware into the glost oven and carrying them out again after the glost firing, as well as the operation of placing the ware in the saggers for glost firing; provided that nothing in these Regulations shall render it obligatory for overalls and head-coverings to be provided for or worn by any man during the time that he is engaged in drawing the glost oven.

"Flow material" means any material containing lead, which is placed in saggers with a view to its entire or partial volatilization during the glost firing of the ware.

"Thimble picking" means the picking over, sorting, or re-arranging for further use, of thimbles, stilts, spurs, strips, saddles, or any similar articles which have been used for the support of articles of pottery during the process of glost firing.

"Efficient exhaust draught," used in connection with a process, means an exhaust draught which effectually removes, as near as possible to the point of origin, the dust generated in the process. No draught shall be deemed to be efficient which fails effectually to remove smoke generated at the point where dust originates in the process.

Duties.

It shall be the duty of the occupier to observe Part I. of these Regulations.

It shall be the duty of all persons employed to observe Part II. of these Regulations.

PART I.

Duties of Occupiers.

Age and sex limits

1. *(4) No woman, young person, or child shall be employed in the following processes:

Stopping of biscuit ware, if stopping material which contains lead and is of solubility exceeding 5 per cent. is used;

* The large figure in brackets indicates the number of the Rule in the Code of 1903, at present in force, by which a similar requirement is enacted.

weighing out, shovelling, or mixing of unfritted lead compounds in the preparation or manufacture of frits, glazes, or colours;

lawning of glaze, except where less than a quart of glaze is lawned at a time;

preparation or weighing out of flow material;

cleaning, as prescribed in Regulation 12, of floors of potters' shops or stoves or any place in which any process included in the Schedule is carried on;

cleaning of boards used in the dipping house, dippers' drying room, ware cleaning room, or glost placing shop;

cleaning of mangles or any part thereof.

No young person or child, other than a male young person who wedges clay only for his own use, shall be employed in the wedging of clay; and no woman shall be so employed without a certificate of permission to work.

No young person or child shall be employed in the carrying of clay, or other systematic carrying or lifting work, without a certificate of permission to work, specifying the maximum weight which he or she may carry; and no young person or child so employed shall be allowed to lift or carry any weight in excess of that named in the certificate. Provided that:—

(*a*) No certificate shall permit the carrying of more than 30 lbs. by anyone under the age of 16 years; and

(*b*) No girl under 16 years of age, and no boy under 15 years of age shall be allowed to carry clay, except that a boy under 15 who is working for himself and is not an attendant of another worker, shall be allowed to carry such clay as is to be used by himself in making articles of pottery.

No female shall be employed as a wheel-turner for a thrower, without a certificate of permission to work.

No person under 16 years of age shall be employed as a lathe-treader.

No young person or child shall be employed as a dipper.

No girl under 17 and no boy under 16 shall be employed as a dipper's assistant or ware cleaner.

No woman, young person, or child shall be employed as a glost placer, except in the placing of china furniture or electrical fittings; and no girl under 17 and no boy under 16 shall be employed as a glost placer in the placing of china furniture or electrical fittings.

(5.) No person under 16 years of age shall be employed in any process included in Part I. of the Schedule; and no person under 15 years of age shall be employed in any process included in Part II. of the Schedule.

2. (6) All persons employed in any process included in Part I. of the Schedule shall be examined once in each calendar month by the Surgeon; and all persons employed in any process included in Part II. of the Schedule shall be examined once in every twelve months by the Surgeon. **Periodical Examination.**

All persons for whom certificates of permission to work are required by Regulation 1 shall be examined by the Surgeon at the commencement of their employment in a process in which such a certificate is required.

All young persons and children employed in the carrying of clay, or other systematic carrying or lifting work, shall be re-examined by the Surgeon twice in the first period of six months, and once in each period of six months thereafter until they attain the age of 18.

Any female examined for employment as a wheel-turner shall be presented for re-examination at a later date, if the Surgeon considers it necessary.

The fees for all medical examinations made in pursuance of these regulations shall be paid by the employer and shall not be charged to the worker, whether he be in regular or casual employment. Provided that casual workers examined at the Surgeon's surgery shall pay a fee of one shilling for each certificate entered in the portable register; this fee shall be refunded by the occupier who first employs the worker after such examination; and the occupier shall record in the portable register the fact that the fee has been refunded.

A notice shall be affixed, in a prominent place in the factory, showing clearly the time appointed for the Surgeon's periodical visit; and an amending notice shall be affixed forthwith if it is found necessary to alter the date or hour; wherever possible, not less than three days' notice of a change of date shall be given.

A private room shall be provided for all medical examinations. Besides the worker, no one shall be present with the Surgeon except such other medical man or relative of the worker as the Surgeon may decide to admit; provided that the mother of a worker shall have the right to attend at that worker's medical examination if a request in writing to that effect has been sent to the Surgeon.

No person after suspension shall be allowed to work in any process in which examination by the Surgeon is required by these regulations, without a certificate of permission to work.

Health, &c. Register.

3. **(7) A register, in the form prescribed shall be kept, in which the Surgeon may enter the dates and results of his visits, the number of persons examined in pursuance of these regulations and particulars of any directions given by him. This register shall contain** a correct **list of all persons employed in the processes included in** the Schedule, and of all persons for whom a certificate has been obtained in pursuance of Regulation 1; as well as all other particulars required to be entered in the register in pursuance of these regulations.

The register shall be open to the inspection of any worker so far as concerns the entries relating to that worker. All such entries as indicate the general health of the worker shall be so expressed as to be readily understood both by occupiers and persons employed.

When a certificate of suspension or permission to work is sent by the Surgeon to the occupier, it shall be forthwith attached to the register, and shall be kept so attached until replaced by a personal entry by the Surgeon in the register.

Overalls and head-coverings.

4. **(8) The occupier shall provide and maintain suitable overalls and head-coverings for** all **persons employed in the processes included in the Schedule**; except that head-coverings need not be provided for persons employed in majolica painting.

Head-coverings shall be adequate to protect the hair from dust, and shall be worn in such a manner as to be effective for this purpose.

The occupier shall provide and maintain suitable aprons of a waterproof or similar material which can be sponged daily, for all dippers, dippers' assistants and ware cleaners; provided that, if the front of the overall supplied to any such worker in pursuance of these regulations is made of a material which can be sponged daily, no separate apron need be provided for that worker.

No person shall be allowed to work in any process included in the Schedule without wearing the above-named **overalls and head-coverings,** as well as aprons when provided in pursuance of the preceding paragraph; except that head-coverings need not be worn by persons employed in majolica painting.

All aprons made of a waterproof or similar material, and all overalls or parts of overalls made of such material, shall be thoroughly cleaned by sponging or other wet process after every time of use. All other overalls or parts of overalls and all head-coverings shall be washed or renewed at least once a week; and the occupier shall provide for washing, renewal, and necessary repairs of all overalls and head-coverings to be done either at the factory or at a laundry; and no worker shall be allowed to take home any overalls, head-coverings, or aprons provided in pursuance of these regulations.

All overalls, head-coverings, and aprons provided in pursuance of these regulations, **when not in use or being washed or repaired, shall be kept in proper custody**; for this purpose there shall be provided a cupboard or cupboards or room or rooms suitably situated and sufficiently large to hold the overalls,

head-coverings, and aprons; a separate peg shall be provided for each worker who is required by these regulations to wear overalls.

5. A cupboard or cupboards or room or rooms shall be provided for workers to deposit clothing put off during working hours; the accommodation provided for this purpose shall be sufficient to hold the outdoor clothing of all workers who are required by these regulations to wear overalls, and a separate peg shall be provided for each such worker; all such cupboards or rooms shall be entirely separated from any source of lead or other dust, and from any place provided for the keeping of overalls, head-coverings, or aprons, and shall be kept thoroughly clean by the occupier. Outdoor Clothing.

The occupier shall make adequate provision for drying such outdoor clothing, if wet, during the time it is put off in working hours; this provision shall not be made in any place where there is any source of lead or other dust, or in any place provided for the keeping of overalls, head-coverings, or aprons, or in any mess-room provided in pursuance of these regulations.

6. (9) No person shall be allowed to keep, or prepare, or partake of any food, drink, or tobacco, or to remain during meal-times in any place in which is carried on any process included in the Schedule, or the process of towing, or the process of tile-making, or any other process which the Inspector of Factories for the District shall certify as sufficiently dusty to render the room in which it is carried on an unsuitable place, in his opinion, for persons to remain during meal-times. Food.

Mess-room accommodation shall be provided for the workers employed in the processes included in the Schedule, and for such others as are excluded from their own workrooms during meal-times in pursuance of paragraph 1 of this regulation.

This accommodation shall consist of a clean, well ventilated, and well lighted room or rooms in which no manufacturing process is carried on; it shall be at or near the factory, and shall be sufficiently large to accommodate all the workers employed in the processes included in the Schedule and all others who are excluded from their own work-rooms during meal-times in pursuance of paragraph 1 of this regulation, allowing floor space in accordance with the following scale:—

In mess-rooms for—

6 persons and under- - -	- $10\frac{1}{2}$ sq. feet per person.
Over 6 persons and up to 12 -	- $7\frac{1}{2}$ „ „
„ 12 „ „ 20 -	- 6 „ „
„ 20 „ „ 28 -	- $5\frac{1}{2}$ „ „
„ 28 „ „ any number	- 5 „ „

Provided that if the Factory Inspector for the District shall certify that in his opinion the special circumstances of any factory are such as to render the provision of mess-room accommodation for all such workers unnecessary, it shall be sufficient to provide accommodation, calculated on the above scale, for such a proportion of all such workers as is named on the certificate of the Factory Inspector; but in no case shall this proportion be less than 50 per cent., subject, in cases of difficulty, to appeal to H. M. Chief Inspector of Factories; and the Factory Inspector for the District shall have the right, at any time, to cancel or amend any such certificate.

All mess-rooms provided in pursuance of this regulation shall be furnished with proper tables and seats; shall be kept at a proper temperature not below 55 degrees Fahrenheit; and shall be thoroughly cleaned daily at the occupier's expense.

No person shall be allowed to take into a mess-room any overall, head-covering, or apron, worn in a process included in the Schedule.

The washing conveniences prescribed by the regulations shall not be maintained in any mess-room.

A suitable place for the deposit of food shall be provided for each worker using the mess-room. Such provision shall not be made in a room in which any manufacturing process is carried on, and shall be subject in each case to the approval of the Factory Inspector for the District.

Adequate facilities shall be provided to enable workpeople to heat their food.

A supply of milk, or cocoa made with milk, shall be provided for all women and young persons working in processes included in Part I. of the Schedule, who commence work before 9 a.m. Not less than half a pint shall be provided for each such worker at the expense of the occupier.

Dust.

7. (10) The following processes shall not be carried on without the use of an efficient exhaust draught:—

The fettling of flat ware, whether china or earthenware, by towing or sandpapering, provided that this shall not apply to the occasional finishing of pieces of china or earthenware without the aid of mechanical power;

The sand-sticking of sanitary ware;

Any other process of fettling on a wheel driven by mechanical power, except where:

(*a*) The fettler is fettling, as an occasional operation, only ware of his or her own making; or

(*b*) The fettling is done wholly with a wet sponge or other moist material.

The sifting of clay dust for making tiles or other articles by pressure, except where:

(*a*) This is done in a machine so enclosed as effectually to prevent the escape of dust; or

(*b*) The material to be sifted is so damp that no dust can be given off.

The pressing of tiles from clay dust, an exhaust opening being connected with each press; this clause shall also apply to the pressing from clay dust of articles other than tiles, unless the material is so damp that no dust is given off.

The fettling of tiles made from clay dust by pressure, except where the fettling is done wholly on or with damp material; this clause shall also apply to the fettling of other articles made from clay dust, unless the material is so damp that no dust is given off.

The processes of bedding and flinting.

The brushing of earthenware biscuit, unless the process is carried on in a room provided with efficient general mechanical ventilation.

Scouring of biscuit ware which has been fired in powdered flint, except where this is done in machines so enclosed as effectually to prevent the escape of dust.

Batting of biscuit ware which has been fired in powdered flint.

Glaze blowing.

Ware cleaning after the application of glaze by dipping or other process, except as set forth later in this regulation.

The preparation or weighing out of flow material.

The lawning of dry colours, except where not more than an ounce at a time is lawned for use in painting.

Ground laying, including the wiping off of colour after its application to the surface of the ware.

Colour dusting, whether under-glaze or on-glaze, including the wiping off of colour after its application to the surface of the ware.

Colour blowing or aerographing, whether under-glaze or on-glaze, including the wiping off of colour after its application to the surface of the ware.

The making of lithographic transfers, including the wiping off of colour after its application to the surface of the transfer sheets.

In the process of mould-making, every bin or similar receptacle used for holding plaster of Paris shall be provided with an efficient exhaust draught so arranged as to prevent the escape of plaster of Paris dust into the air of the workplace; except where a cover is provided for the bin or other receptacle, and the plaster of Paris is conveyed in a sack, the mouth of which is tied and only loosened after it has been placed in the bin or other receptacle.

The dry grinding of materials for pottery bodies shall be done either with an efficient exhaust draught for the removal of dust, or in machines so enclosed as effectually to prevent the escape of dust; except that it shall not be deemed necessary in pursuance of this regulation to provide an exhaust draught to remove small

amounts of dust given off at the hopper of an enclosed machine in the course of feeding the same, if an outlet into an exhaust duct or to the outside air is fitted to the receptacle into which the powdered material is delivered.

In the process of making tiles from clay dust by pressure, supplies of material shall be conveyed to the work benches in such a manner as to disperse as little dust as possible into the air; clay dust shall not be carried into any press shop in sacks. This clause shall also apply to the making from clay dust of articles other than tiles, unless the material is so damp that no dust is given off.

Biscuit flat ware which has been bedded for firing shall not be removed from the saggers after firing, except at a bench fitted with an efficient exhaust appliance for the removal of dust.

Flat-knocking and fired-flint-sifting shall be carried on only in enclosed receptacles, which shall be connected with an efficient exhaust **draught unless so contrived as to prevent effectually the escape of dust.**

In the process of ware cleaning of earthenware after the application of glaze by dipping or other process, **damp sponges or other damp material shall be provided in addition to the knife or other instrument, and shall be used wherever practicable.**

Nothing in these regulations shall render it compulsory to provide an exhaust draught for ware cleaning if this process is carried on entirely with the use of wet materials; or if the ware cleaning be done within 15 minutes after the moment when the glaze was applied; but an efficient exhaust draught shall always be provided and used if any dry materials or implements, such as knives or scrapers, are used after the glaze is dry or more than 15 minutes after the moment when the glaze was applied.

In the process of ware cleaning, after the application of glaze by dipping or other process, **sufficient arrangements shall be made for any glaze, scraped off** which is **not removed** by the exhaust draught **to fall into water.** All water troughs or other receptacles provided in pursuance of this clause shall be cleaned out and supplied with fresh water as often as necessary, and in no case less often than once a week; and no scrapings of glaze shall be allowed to collect in a dry condition on the sides of the water receptacle. Where grids or gratings are fitted over the water trough or other receptacle named in the foregoing paragraph, they shall be kept clean by repeated sponging or wiping with wet material during the time that the process of ware cleaning is being carried on. No boards or other articles shall be placed, even temporarily, on any such water trough, in such a way as to interfere with the efficient use of the trough.

In all processes the occupier shall, as far as practicable, adopt efficient measures for the removal of dust and for the prevention of any injurious effects arising therefrom.

Every process for which an exhaust draught is prescribed shall be carried on inside a hood or exhaust funnel; provided that, where the occupier can show that this is impracticable, it shall be sufficient if the work is done within the effective range of an exhaust opening.

8. **(11)** No person shall be allowed to work without wearing a suitable and efficient respirator, such as a damp sponge tied across the mouth and nostrils, in any of the following processes:— Respirators.

The emptying of sacks of plaster of Paris into the bin in a mould-making shop;

The weighing out, shovelling, or mixing of unfritted lead compounds, in the preparation or manufacture of frits, glazes or colours containing lead, or any process carried on in a room wherein any such weighing out, shovelling, or mixing has taken place within the previous 30 minutes;

unless an efficient exhaust draught is provided to prevent the escape of dust into the air of the workplace.

All respirators required by this regulation **shall be provided and maintained** in a cleanly state **by the occupier**; and **each respirator shall bear the distinguishing mark of the worker to whom it is supplied.**

Ventilation.

9. (12.) Every place in which any worker or workers are employed shall be thoroughly ventilated.

All workrooms in which articles are left to dry shall be ventilated in such a way as to ensure a continuous movement of the air in the room in a direction away from the workers and towards the articles in question.

All drying stoves shall be ventilated direct to the outside air by shafts having upward inclinations and terminating vertically, or by louvres in the roof, or by other effective means.

All mangles shall be so ventilated as to provide for the maintenance of a flow of air into the hot chamber from the adjoining workroom.

In the case of vertical or "tower" mangles:

(*a*) The pipes for heating the mangle shall be fixed above the top of any opening at which workers put in or take off ware; and

(*b*) There shall be a free outlet into the air above, so formed and placed as to ensure an outflow whatever the direction of the wind.

Fresh air shall, where practicable, be admitted to all workrooms by inlets placed along the sides of the room at a height of as nearly as possible 6 feet above the floor level, hopper openings being used for the purpose wherever possible.

Where it is not practicable to provide such fresh air inlets arrangements shall be made for the entry of an adequate amount of pure air by a flue with apertures at intervals along its length, or other means, which will secure an even distribution of the air through the room.

In no case shall fresh air inlets be so arranged that a draught can blow direct from them on to any worker.

Wherever the natural air currents are found to be insufficient without assistance to afford thorough ventilation, exhaust fans or other artificial means of creating a current of air shall be provided and maintained in use.

Where an exhaust draught is provided for the removal of dust generated in a manufacturing process, precautions shall be taken to prevent dust being drawn into the general atmosphere of the room from other sources of dust in places in the vicinity; communication with such places shall be stopped wherever possible, and the fresh air inlets hereinbefore mentioned shall be so arranged as to ensure that no extraneous dust is drawn towards the workers by the exhaust draught.

Temperature, etc.

10. Such a condition of the atmosphere shall be maintained in all workrooms that the reading of the wet-bulb thermometer shall not exceed 70° Fahrenheit, except at such times as the reading of the wet-bulb thermometer in the shade in the open air exceeds 65° Fahrenheit.

Provided that the Secretary of State may, by Order—

(*a*) grant exemptions from this regulation in the case of any special branch of the industry, if it can be shown that every means has been tried for the purpose of conforming to the prescribed limit;

(*b*) prescribe a limit higher than 70° Fahrenheit in the case of printing shops, if it can be shown to be necessary.

Thermometers.—A thermometer, suitably mounted for observing the wet-bulb reading, shall be provided in every workroom in which any articles are allowed to dry, or in connection with which artificial heat is used in aid of the manufacturing process, whether in the workroom itself or in drying stoves or mangles or other appliances adjoining the workroom.

Steam or hot water pipes.—Wherever steam or hot water pipes pass through a workroom, they shall be efficiently protected, and if not used for the purpose of heating that room, they shall be efficiently covered with non-conducting material.

Drawing of ovens.—The following regulations shall apply to the drawing of ovens:—

The temperature, whether taken at the bottom of the stage where the top drawer stands, or at any lower stage where men are working, shall not exceed 125° Fahrenheit.

Except that, in the case of any oven in which—

(*a*) cooling dampers are in use, and in respect of which

(*b*) there has been no unnecessary delay in setting in the oven,

it shall be permissible, on the joint agreement of employer and employed, to suspend the above rule not more than four times in any period of twelve months; but such suspension of the rule shall be conditional on immediate notice being sent to H.M. Inspector of Factories for the District, stating the name or number of the oven which is being drawn at a temperature exceeding 125° Fahrenheit, taken as above. For the purpose of this exception, every oven to which it applies shall be given a distinctive name or number which shall be recorded in the register. Particulars of any notice sent to the Inspector of Factories for the District in pursuance of this exception shall also be recorded in the register.

When notice is given by the oven-men, whether verbally to the manager or occupier, or by handing in a written notice at the office before 5.30 p.m., to the effect that the oven-men wish to have the temperature tested before the oven is drawn next day, arrangements shall be made for a responsible representative of the occupier to be present for the purpose at the time when the drawing in question commences.

The temperature of ovens shall also be taken, on a demand being made by the oven-men, at any time when they are engaged in drawing.

11. (13) **The occupier shall provide and continually maintain, for the use of all persons employed in processes named in the schedule, at least one lavatory basin for every five such persons.** Each such basin shall be provided with a waste pipe and plug, or the basins shall be placed on a trough fitted with a waste pipe. There shall be a constant supply of hot and cold water laid on to each basin. Lavatories.

Or, in the place of basins, the occupier shall provide and maintain troughs of enamel or similar smooth impervious material, in good repair, of a total length of at least two feet for every five such persons employed, fitted with waste pipes, and without plugs, with a sufficient supply of warm water constantly available from taps or jets above the trough at intervals of not more than two feet.

The lavatory shall be kept thoroughly cleaned at the cost of the occupier.

Before each meal and before the end of the day's work, at least ten minutes, in addition to the regular meal-times, shall be allowed for washing to each such person, provided that if the lavatory accommodation specially reserved for such persons exceeds that required by the preceding paragraphs, the time allowance may be proportionately reduced, and that if there be one basin or two feet of trough for each such person, no allowance of time shall be required.

The lavatories shall be under cover and shall be fitted up as near as practicable to the places in which the workers for whom they are provided are employed.

There shall be in front of each washing basin, or trough, a space for standing room which shall not be less in any direction than 21 inches.

Sufficient space shall be provided under cover in or adjoining the lavatory for such workers as use the lavatory while awaiting their turn to wash.

Towels.—One roller towel, fastened in position, at least 15 square feet in area, shall be provided for every three workers, and shall be washed or renewed daily.

Or, one roller towel, fastened in position, at least 15 square feet in area, shall be provided for every nine workers, and shall be washed or renewed after every meal-time and at the close of the day's work.

Or, a towel at least 5 square feet in area shall be provided for each worker, and shall be washed or renewed daily; in this case a peg with the worker's name shall be provided for each towel.

Nail Brushes.—One nail brush shall be provided for each basin or every two feet of trough, and shall be maintained in a cleanly and efficient condition. If fastened down, it shall be taken up once a week, and cleaned or renewed.

Soap.—A sufficient supply of soap shall be always available at each basin, or every two feet of trough.

Separation of Sexes.—Separate lavatories for males and females shall be provided. An adjustable wooden partition across a lavatory shall be deemed to be sufficient separation, provided that it ensures complete privacy for females while washing.

Floors, etc

12. (14.) The floors of all slip-houses shall be kept thoroughly clean by mopping or swilling.

In all potters' shops, including such drying stoves as are entered by workpeople, and in all places where the following processes are carried on, viz.:—

Making or mixing of frits, glazes, or colours containing lead,
Application of majolica, or other glaze, by blowing, painting, or other process,
Preparation, or weighing out, of flow material,
Ground laying, including the wiping off of colour after this process,
Colour dusting } whether on-glaze or under-glaze, including the wiping
Colour blowing } off of colour after either of these processes,
Colour grinding for colour blowers,
Lithographic transfer making,

the following regulations shall apply:—

Construction.—There shall be provided and maintained:—

Either impervious floors;

Or wooden floors with a thoroughly smooth and sound surface, constructed in such a substantial manner as to be free from permanent sag, and maintained in such repair that they can be properly cleaned by a moist method, and that no dust can fall through into rooms below.

Daily Cleaning of Floors.—The floors, when the rooms are in use, shall be thoroughly cleaned daily, by a moist method, by an adult male after work has ceased for the day, and before 3 a.m. next morning; except that in rooms in which ground laying is done, the cleaning prescribed by this regulation may be done before work commences in the morning, provided that in no case shall any work be carried on in the room within one hour after such cleaning as aforesaid has ceased.

Removal of Scraps, etc.—Scraps of clay and other débris, including any which have collected under benches, shall not be allowed to accumulate unduly, and all such scraps and débris shall be carried out at least once a day. Scraps of clay in potters' shops shall be damped before being carried out.

In all drying stoves which are entered by workpeople, boxes shall be provided for the reception of broken or waste clay ware.

Storage of Moulds.—Suitable provision shall be made for the storage of all moulds when not in use, and the tops of drying stoves shall not be used for this purpose unless such places are boarded up to form cupboards.

The floors of all biscuit placing and glost placing shops shall be impervious, even floors of brick, flag or similar hard material, and shall be kept in good repair; they shall be thoroughly sprinkled and swept by an adult male whenever the work of setting in an oven has ceased, and under any circumstances at least once a day.

The floors of all dipping houses, dippers' drying rooms, and ware cleaning rooms shall be washable impervious floors, properly sloped towards a drain, and shall be thoroughly cleaned daily by an adult male, after work has ceased for the day, with a jet of water and a mop or similar implement; provided that, in the case of china dippers' drying rooms, this cleaning may be done before work commences in the morning, instead of after work has ceased for the day.

Where steam pipes are used for heating a drying stove, dipper's drying room, or any place where articles are left to dry, the pipes shall, if possible, be fixed in the form of a rack of horizontal pipes in a vertical plane. Where this is impossible, the pipes shall be fixed in such a position as to allow a thorough cleaning under and around them.

All stillages shall be so arranged as to allow the floor to be thoroughly cleaned underneath them.

In all workrooms not specially mentioned in the foregoing paragraphs of this regulation, the following regulations shall apply:—

All floors shall be maintained in such repair that they can be properly cleaned by a moist method, and shall be so cleaned daily.

All ashes, dirt or other débris, including any which have accumulated under benches, shall be carried out daily.

13. The following regulations shall apply to work benches in potters' shops, and in places where processes named in the Schedule are carried on:— Work benches.

Work benches, if not covered with sheet metal or constructed with an impervious surface, shall be strongly and solidly constructed of closely jointed timber, and the surface of the work benches shall be well maintained.

All work benches in use shall be thoroughly cleaned daily by a moist method.

14. Raw lead compounds shall not be handled except with at least 5 per cent. of added moisture. Lead-house, etc.

They shall, further, be kept in their original packages until weighed out, and the tub or other receptacle containing them shall be so fitted either with a cover or a damp screen as to prevent the issue of any lead dust from its mouth.

In every lead-house a special lavatory basin with a supply of hot and cold water, nail brush, soap, and towel shall be provided and maintained; and a solution of soluble sulphides shall be provided in which workers in the lead-house shall rinse their hands after washing so as to show if they are free from lead.

15. In dipping houses, all parts of walls sufficiently near to any dipping tub to be splashed with glaze shall be tiled, or painted with washable paint, or otherwise treated in such a manner as to permit of thorough cleaning by a wet process. Dipping house, etc.

The above-named parts of walls, as well as the dipping tubs and any other objects which are splashed with glaze, shall be thoroughly cleaned daily by a wet process.

All dipping houses and ware cleaning rooms shall be well lighted; neither dipping nor ware cleaning shall be done in places which, in ordinary fine weather, are dependent on borrowed light or artificial light during the hours of daylight.

16. In the process of threading-up, rubber or other washers, used to keep articles apart when being dipped, shall be thoroughly washed in a colander after each dipping. Wires shall also be washed after each dipping. Threading-up.

17. (15.) Every board on which dipped ware has been placed shall, on each occasion after it has been used for one set of articles and before being used for another, shall be thoroughly cleaned with clean water by an adult male. Boards.

"Nailed" or "pegged" boards shall be cleaned under a strong jet of water; no new boards of this description shall be introduced except where necessary to hold china furniture or other special articles which cannot be carried on ribbed or plain boards.

Boards for use in processes included in Part I. of the Schedule shall be clearly marked by painting them red at the ends and for a distance of at least six inches from each end of the board on both sides, so as to distinguish them from other boards which do not come into contact with lead. Boards so marked shall not be used in any department unless they have been thoroughly cleaned, and shall not be used in the clay departments under any circumstances. Boards not so marked shall not be taken into any place where a process included in Part I. of the Schedule is carried on.

18. All mangle shelves shall be thoroughly cleaned by a wet process, by an adult male, every Saturday afternoon after work has ceased for the week. Mangles.

19. All material collected from floors or work benches shall be riddled in an enclosed receptacle before it is taken to a thimble picking room. Thimble picking.

20. The following regulations shall apply to the process of majolica painting:— Majolica painting.

A sponge and bowl of clean water, to rinse the fingers, shall be provided on the work bench beside each person employed in majolica painting.

In all majolica painting shops where there is no adjoining lavatory accommodation, there shall be provided in the room a lavatory sink with a tap, a constant supply of water, and towels.

All splashes of glaze falling on the benches, or surrounding objects, shall be immediately removed with a wet sponge or other wet material.

No floor or work bench shall be deemed to have been thoroughly cleaned, in accordance with Regulation 13 or 14, unless all splashes of glaze have been completely removed.

Mottling, or any similar method of applying glaze, shall only be carried on under the regulations applying to majolica painting.

All cleaning and scraping, including panel-cutting, after majolica dipping, painting, or blowing, shall be deemed to be ware cleaning, and shall only be done in compliance with the rules for the latter process.

Cotton-wool in ground laying, colour dusting, and lithographic transfer making.

21. All pieces of cotton-wool or similar materials which have been used in the process of ground laying, or colour dusting, or lithographic transfer making, shall be kept in a proper receptacle. All pieces of waste cotton-wool or similar materials which have been so used shall be immediately burnt.

Aerographing

22. *Short-sighted workers.*—No short-sighted person shall be employed to do glaze or colour blowing, unless wearing suitable glasses. No person shall be employed as a glaze or colour blower, unless the surgeon has entered in the health register a certificate stating that he has examined the worker's sight and is satisfied that he or she can be so employed without breach of this regulation.

Hoods.—All hoods in which the blowing of glaze or colour is carried on shall be thoroughly cleaned daily by a wet process.

Prohibition of blowing with the mouth.—Glaze or colour blowing shall not be done with the mouth.

Clay slips.—Decoration on unfired clay ware by means of coloured clay slips shall not be regarded as colour blowing for the purposes of any of the regulations applying specially to the latter process.

Lithographic transfer making.

23. *Cleaning of machines.*—Machines used in lithographic transfer making shall not be brushed down, but shall be cleaned either—

(*a*) with moist materials, such as oily rags, in such a manner as not to disperse any dust into the air; or

(*b*) by means of an exhaust current of air, such as that afforded by a vacuum-cleaner.

Separation of processes.

24. (5) **Thimble picking or threading-up shall not be carried on except in a place sufficiently separated from any process included in the Schedule.**

When a process included in the Schedule is being carried on in a room where other work is also done

Either the place where the scheduled process is carried on shall be screened off from the rest of the room by a partition not less than eight feet high,

Or, all persons working in the room shall be deemed to be persons employed in the scheduled process.

Hours of employment.

25. No person shall be employed for more than four hours without an interval of at least half an hour for a meal; provided that this regulation shall not apply to adult males employed as engineers, firemen or millers, or as attendants of such workers.

No woman or young person who is employed in any process included in Part I. of the Schedule shall be employed in the factory in any capacity for more than 46 hours in any week.

No adult male who is employed as a dipper, dipper's assistant or ware cleaner shall be employed in the factory in any capacity for more than 48 hours in any week.

No adult male who is employed as a glost placer shall be employed in the factory in any capacity for more than 54 hours in any week.

Except that it shall be permissible to employ adult male dippers, dippers' assistants, ware cleaners, and glost placers overtime, in addition to the prescribed weekly periods of 48 and 54 hours; provided that such overtime shall not, in any factory to which these regulations apply, exceed 4 hours in any week, or 36 hours in any period of twelve months. The occupier shall enter in the prescribed register particulars of all such overtime, and shall also send notice with the prescribed particulars, to the Factory Inspector for the District, before eight o'clock in the evening on any day when a man is employed overtime in pursuance of this exception.

An occupier who avails himself of this exception shall, if called upon, produce to the Factory Inspector for the District evidence of press of orders or other circumstance rendering the overtime necessary.

In potters' shops, and in any place where towing or any other dusty process is carried on, including any process for which a certificate by an Inspector of Factories has been given in pursuance of the first paragraph of Regulation 6, no woman or young person shall be employed for more than $9\frac{1}{2}$ hours in any day.

All the above weekly and daily periods shall be the maximum permissible periods of actual work, exclusive of meal-times.

26. If at any time it is shown to the satisfaction of the Secretary of State in the case of any manufacture or process or any operation forming part thereof, that injury to health is adequately prevented by other appliances or under other conditions than those prescribed by these regulations, the Secretary of State may, by Order, modify the whole or any part of the regulations so far as they apply to such manufacture or process. Any such Order may be revoked, modified, or extended by further Order. Modification of Regulations.

27. In addition to the printed copies of these regulations required to be kept posted up in pursuance of Section 86 of the Factory and Workshop Act, 1901, there shall be kept constantly affixed in every potters' shop and in every place in which any process included in the Schedule is carried on, a notice printed in bold type so that it can be easily read, setting forth those portions of the regulations which apply to that particular workplace. Affixing of Regulations.

28. A person or persons shall be appointed, who shall see to the observance of the regulations. The names of the persons so appointed shall be recorded in the register. Observance of Regulations.

The persons so appointed shall record in the register once in each week the prescribed details in regard to the prescribed questions concerning the observance of the regulations.

Copies of the prescribed questions and the weekly entries shall be published each week by affixing them in a prominent place in the factory as well as in the mess-rooms.

29. (3) The occupier shall allow any of His Majesty's Inspectors of Factories to take at any time sufficient samples for analysis of any material in use or mixed for use. Samples for analysis.

Provided that the occupier may at the time when the sample is taken, and on providing the necessary appliances, require the Inspector to take, seal, and deliver to him a duplicate sample.

But no analytical result shall be disclosed or published in any way except such as shall be necessary to establish a breach of these regulations.

Part II.

Duties of Persons Employed.

30. **(16) All persons employed in the processes included in** the **Schedule shall present themselves at the appointed times for examination by the Surgeon as provided in** Regulation 2. Periodical examination.

No person after suspension shall work in any process in which examination by the Surgeon is required by these regulations **without a certificate of** permission to work.

31. **(17)** All **persons employed in any process included in** the **Schedule shall, when at work, wear overalls, head-coverings,** and aprons, as required by Regulation 4. The said overalls, head-coverings and aprons **shall not be worn outside the factory or workshop, and shall not be removed therefrom except for the purpose of being washed or repaired.** No overalls, head-coverings or aprons, provided in pursuance of Regulation 4, shall, under any circumstances, be taken to a worker's home. Overalls.

The head-coverings provided in accordance with Regulation 4 shall be worn in such a manner as effectually to protect the hair from dust, and the hair must be so arranged as to permit of this.

The overalls, head-coverings, and aprons, when not being worn, and clothing put off during working hours, shall be deposited in the respective places provided by the occupier for such purposes under these regulations.

Respirators shall be worn as required by Regulation 8.

Food. 32. (18) No person shall introduce, keep, prepare, or partake of any food, drink, or tobacco, or remain during meal-times in any place in which is carried on any process included in the Schedule, or the process of towing, or the process of tile-making, or any other process which the Inspector of Factories for the District shall certify as sufficiently dusty to render the room in which it is carried on an unsuitable place, in his opinion, for persons to remain during meal-times.

Every worker for whom milk or cocoa is provided in accordance with Regulation 6 shall drink the same, unless a medical certificate is produced showing cause for exemption from this requirement.

Ventilation. Dust. 33. (19) No person shall in any way interfere, without the knowledge and concurrence of the occupier or manager, with the means and appliances provided by the employers for ventilation, and for the removal of dust.

Washing. 34. (20) No person employed in any process included in the Schedule shall leave the works or partake of meals without previously and carefully cleaning and washing his or her hands.

No person employed shall remove or damage the washing basins or conveniences provided under these regulations.

Cleaning of work places. 35. (20a) The persons appointed by the occupiers shall clean the several floors, walls, work benches, appliances and other objects regularly as prescribed in these regulations.

Boards. 36. (21) The boards used in the dipping house, dippers' drying room, or glost placing shop shall not be used in any other department, except after being cleaned, as directed in Regulation 17.

No board on which dipped ware has been placed shall be used for a second set of dipped articles until it has been thoroughly cleaned, in accordance with Regulation 17.

Boards which are marked for use in lead processes shall not be used in any department unless they have been thoroughly cleaned, and shall not be used in the clay departments under any circumstances.

Avoidance of dust, etc. 37. (20a) Every worker shall so conduct his or her work as to comply strictly with these regulations, and to avoid, as far as practicable, making or scattering dust, dirt, or refuse, or causing accumulation of such.

SCHEDULE.

PART I.—LEAD PROCESSES.

Making or mixing of fritts, glazes, or colours containing lead.

Dipping or other process carried on in the dipping house.

Application of majolica, or other glaze, by blowing, painting, or other process.

Drying after the application of glaze by dipping, blowing, painting, or other process.

Ware cleaning after the application of glaze by dipping, blowing, painting, or other process.

Glost placing.

Preparation, or weighing out, of flow material containing lead.

Ground laying, including the wiping off of colour after this process.

Colour dusting } whether on-glaze or under-glaze, including the wiping
Colour blowing } off of colour after either of these processes.

Colour grinding for colour blowers.

Lithographic transfer making.

Any other process in which materials containing lead are used or handled in the dry state, or in the form of spray, or in suspension in liquid other than oil or similar medium; provided that the stopping of biscuit ware with a material containing lead shall not be deemed to be a process included in this schedule.

Part II.—Other Processes.

Scouring of biscuit ware which has been fired in powdered flint.

Emptying of biscuit ware which has been fired in powdered flint, from the baskets or other receptacles in which it has been conveyed to the biscuit warehouse or scouring shop.

PROPOSED REGULATIONS

Under Section 79 of the Factory and Workshop Act, 1901,

For the Manufacture of Lithographic Transfers for Pottery.

Definitions.

In these regulations:—

"Surgeon" means the Certifying Factory Surgeon of the District, who shall have, as regards all persons examined by him in pursuance of these regulations, power of suspension and of permission to work, by certificate which may either be entered in the health register by the Surgeon personally, or be sent by him to the occupier.

"Entered in the health register" means:

(*a*) Entered in the prescribed register kept at the factory in pursuance of Regulation 3; or

(*b*) Entered in the portable register prescribed for the use of casual workers.

"Suspension" means suspension, by signed certificate of the Surgeon, from employment in any process in which examination by the Surgeon is required by these regulations.

"Permission to work" means permission, by signed certificate of the Surgeon, either:

(*a*) Terminating a suspension, or

(*b*) Permitting employment of a certain specified kind.

"Efficient exhaust draught," used in connection with a process, means an exhaust draught which effectually removes, as near as possible to the point of origin, the dust generated in the process. No draught shall be deemed to be efficient which fails effectually to remove smoke generated at the point where dust originates in the process.

Duties.

It shall be the duty of the occupier to observe Part I. of these Regulations.

It shall be the duty of all persons employed to observe Part II. of these Regulations.

Part I.

Duties of Occupiers.

Age and sex limits.

1. **No woman, young person, or child shall be employed in the** weighing out, shovelling, or mixing of unfritted lead compounds in the preparation or manufacture of colours; or in the cleaning of floors, as prescribed in Regulation 11

No person under 16 years of age shall be employed.

Periodical Examination.

2. **All persons employed shall be examined once in each calendar month by the Surgeon.**

The fees for all medical examinations made in pursuance of these regulations shall be paid by the employer and shall not be charged to the worker, whether he be in regular or casual employment. Provided that casual workers examined at the Surgeon's surgery shall pay a fee of one shilling for each certificate entered in the portable register; this fee shall be refunded by the occupier who first employs the worker after such examination; and the occupier shall record in the portable register the fact that the fee has been refunded.

A notice shall be affixed, in a prominent place in the factory, showing clearly the time appointed for the Surgeon's periodical visit; and an amending notice shall be affixed forthwith if it is found necessary to alter the date or hour; wherever possible, not less than three days' notice of a change of date shall be given.

A private room shall be provided for all medical examinations. Besides the worker, no one shall be present with the Surgeon except such other medical man or relative of the worker as the Surgeon may decide to admit; provided that the mother of a worker shall have the right to attend at that worker's medical examination if a request in writing to that effect has been sent to the Surgeon.

No person after suspension shall be allowed to work without a certificate of permission to work.

Health, &c. Register.

3. **A register, in the form prescribed shall be kept, in which the Surgeon may enter the dates and results of his visits, the number of persons examined in pursuance of these regulations and particulars of any directions given by him. This register shall contain a** correct **list of all persons employed,** as well as all other particulars required to be entered in the register in pursuance of these regulations.

The register shall be open to the inspection of any worker so far as concerns the entries relating to that worker. All such entries as indicate the general health of the worker shall be so expressed as to be readily understood both by occupiers and persons employed.

When a certificate of suspension or permission to work is sent by the Surgeon to the occupier, it shall be forthwith attached to the register, and shall be kept so attached until replaced by a personal entry by the Surgeon in the register.

Overalls and head coverings

4. **The occupier shall provide and maintain suitable overalls and head-coverings for** all **persons employed.**

Head-coverings shall be adequate to protect the hair from dust, and shall be worn in such a manner as to be effective for this purpose.

No person shall be allowed to work without wearing the abovenamed **overalls and head-coverings.**

All overalls and head-coverings shall be washed or renewed at least once a week; and the occupier shall provide for washing, renewal, and necessary repairs of all overalls and head-coverings to be done either at the factory or at a laundry; and no worker shall be allowed to take home any overalls or head-coverings provided in pursuance of these regulations.

All overalls and **head-coverings** provided in pursuance of these regulations, **when not in use or being washed or repaired, shall be kept in proper custody**; for this purpose there shall be provided a cupboard or cupboards or room or rooms suitably situated and sufficiently large to hold the overalls, and head-coverings; a separate peg shall be provided for each worker who is required by these regulations to wear overalls.

Outdoor Clothing.

5. A cupboard or cupboards or room or rooms shall be provided for workers to **deposit clothing put off during working hours**; the accommodation provided for this purpose shall be sufficient to hold the outdoor clothing of all

workers, and a separate peg shall be provided for each worker; all such cupboards or rooms shall be entirely separated from any source of lead or other dust, and from any place provided for the keeping of overalls or head-coverings, and shall be kept thoroughly clean by the occupier.

The occupier shall make adequate provision for drying such outdoor clothing, if wet, during the time it is put off in working hours; this provision shall not be made in any place where there is any source of lead or other dust, or in any place provided for the keeping of overalls or head-coverings, or in any mess-room provided in pursuance of these regulations.

6. (9) **No person shall be allowed to keep, or prepare, or partake of any food, drink, or tobacco, or to remain during meal-times in** any **workplace.** Food.

Mess-room accommodation shall be provided. This accommodation shall consist of a clean, well ventilated, and well lighted room or rooms in which no manufacturing process is carried on; it shall be at or near the factory, and shall be sufficiently large to accommodate all the workers employed, allowing floor space in accordance with the following scale:—

In mess-rooms for:—

6 persons and under- - -	- $10\frac{1}{2}$ sq. feet per person.
Over 6 persons and up to 12 -	- $7\frac{1}{2}$,, ,,
,, 12 ,, ,, 20 -	- 6 ,, ,,
,, 20 ,, ,, 28 -	- $5\frac{1}{2}$,, ,,
,, 28 ,, ,, any number	- 5 ,, ,,

Provided that if the Factory Inspector for the District shall certify that in his opinion the special circumstances of any factory are such as to render the provision of mess-room accommodation for all such workers unnecessary, it shall be sufficient to provide acommodation, calculated on the above scale, for such a proportion of all such workers as is named on the certificate of the Factory Inspector; but in no case shall this proportion be less than 50 per cent., subject, in cases of difficulty, to appeal to H.M. Chief Inspector of Factories; and the Factory Inspector for the District shall have the right, at any time, to cancel or amend any such certificate.

All mess-rooms provided in pursuance of this regulation shall be furnished with proper tables and seats; shall be kept at a proper temperature not below 55 degrees Fahrenheit; and shall be thoroughly cleaned daily at the occupier's expense.

No person shall be allowed to take into a mess-room any overall or head-covering, worn during work.

The washing conveniences prescribed by the regulations shall not be maintained in any mess-room.

A suitable place for the deposit of food shall be provided for each worker using the mess-room. Such provision shall not be made in a room in which any manufacturing process is carried on, and shall be subject in each case to the approval of the Factory Inspector for the District.

Adequate facilities shall be provided to enable workpeople to heat their food.

A supply of milk, or cocoa made with milk, shall be provided for all women and young persons who commence work before 9 a.m. Not less than half a pint shall be provided for each such worker at the expense of the occupier.

7. **The making of lithographic transfers,** including the wiping off of colour after its application to the surface of the transfer sheets, **shall not be carried on without the use of an efficient exhaust draught.** Dust.

8. (11) **No person shall be allowed to work without wearing a suitable and efficient respirator,** such as a damp sponge tied across the mouth and nostrils, **in the weighing out, shovelling, or mixing of unfritted lead compounds, in the preparation or manufacture of colours containing lead,** or any process carried on in a room wherein any such weighing out, shovelling, or mixing has taken place within the previous 30 minutes; unless an efficient exhaust draught is provided to prevent the escape of dust into the air of the workplace. Respirators.

All respirators required by this regulation **shall be provided and maintained** in a cleanly state **by the occupier; and each respirator shall bear the distinguishing mark of the worker to whom it is supplied.**

Ventilation.

9. Every place in which any worker or workers are employed shall be thoroughly ventilated.

Fresh air shall, where practicable, be admitted to all workrooms by inlets placed along the sides of the room at a height of as nearly as possible 6 feet above the floor level, hopper openings being used for the purpose wherever possible.

Where it is not practicable to provide such fresh air inlets arrangements shall be made for the entry of an adequate amount of pure air by a flue with apertures at intervals along its length, or other means, which will secure an even distribution of the air through the room.

In no case shall fresh-air inlets be so arranged that a draught can blow direct from them on to any worker.

Wherever the natural air currents are found to be insufficient without assistance to afford thorough ventilation, exhaust fans or other artificial means of creating a current of air shall be provided and maintained in use.

Where an exhaust draught is provided for the removal of dust generated in a manufacturing process, precautions shall be taken to prevent dust being drawn into the general atmosphere of the room from other sources of dust in places in the vicinity; communication with such places shall be stopped wherever possible, and the fresh air inlets hereinbefore mentioned shall be so arranged as to ensure that no extraneous dust is drawn towards the workers by the exhaust draught.

Lavatories

10. **The occupier shall provide and continually maintain for the use of all persons employed at least one lavatory basin for every five persons.** Each such basin shall be provided with a waste pipe and plug, or the basins shall be placed on a trough fitted with a waste pipe. There shall be a constant supply of hot and cold water laid on to each basin.

Or, in the place of basins, the occupier shall provide and maintain troughs of enamel or similar smooth impervious material, in good repair, of a total length of two feet for every five such persons employed, fitted with waste pipes, and without plugs, with a sufficient supply of warm water constantly available from taps or jets above the trough at intervals of not more than two feet.

The lavatory shall be kept thoroughly cleaned at the cost of the occupier.

Before each meal and before the end of the day's work, at least ten minutes, in addition to the regular meal-times, shall be allowed for washing to each such person, provided that if the lavatory accommodation specially reserved for such persons exceeds that required by the preceding paragraph, the time allowance may be proportionately reduced, and that if there be one basin or two feet of trough for each such person, no allowance of time shall be required.

The lavatories shall be under cover and shall be fitted up as near as practicable to the places in which the workers for whom they are provided are employed.

There shall be in front of each washing basin, or trough, a space for standing room which shall not be less in any direction than 21 inches.

Sufficient space shall be provided under cover in or adjoining the lavatory for such workers as use the lavatory while awaiting their turn to wash.

Towels.—One roller towel, fastened in position, at least 15 square feet in area shall be provided for every three workers, and shall be washed or renewed daily.

Or, one roller towel, fastened in position, at least 15 square feet in area, shall be provided for every nine workers, and shall be washed or renewed after every meal-time and at the close of the day's work.

Or, a towel at least 5 square feet in area shall be provided for each worker, and shall be washed or renewed daily; in this case a peg with the worker's name shall be provided for each towel.

Nail Brushes.—One nail brush shall be provided for each basin or every two feet of trough, and shall be maintained in a cleanly and efficient condition. If fastened down, it shall be taken up once a week, and cleaned or renewed.

Soap.—A sufficient supply of soap shall be always available at each basin, or every two feet of trough.

Separation of Sexes.—Separate lavatories for males and females shall be provided. An adjustable wooden partition across a lavatory shall be deemed to be sufficient separation, provided that it ensures complete privacy for females while washing.

11. The floors of all workplaces shall be subject to the following regulations:— Floors.

Construction.—There shall be provided and maintained:—

Either impervious floors;

Or wooden floors with a thoroughly smooth and sound surface, constructed in such a substantial manner as to be free from permanent sag, and maintained in such repair that they can be properly cleaned by a moist method, and that no dust can fall through into rooms below.

Daily Cleaning of Floors.—The floors, when the rooms are in use, shall be thoroughly cleaned daily by a moist method, by an adult male after work has ceased for the day, and before 3 a.m. next morning.

Removal of Scraps, etc.—Scraps and débris, including any which have collected under benches, shall not be allowed to accumulate unduly, and all such scraps and débris shall be carried out at least once a day.

12. Work benches, if not covered with sheet metal or constructed with an impervious surface, shall be strongly and solidly constructed of closely jointed timber, and the surface of the work benches shall be well maintained. Work benches.

All work benches in use shall be thoroughly cleaned daily by a moist method.

13. All pieces of cotton-wool or similar materials which have been used in the process of lithographic transfer making, shall be kept in a proper receptacle. All pieces of waste cotton-wool or similar materials which have been so used shall be immediately burnt. Cotton-wool.

14. Machines used in lithographic transfer making shall not be brushed down, but shall be cleaned either— Cleaning of machines.

(*a*) with moist materials, such as oily rags, in such a manner as not to disperse any dust into the air; or

(*b*) by means of an exhaust current of air, such as that afforded by a vacuum-cleaner.

15. No person shall be employed for more than four hours without an interval of at least half an hour for a meal; provided that this regulation shall not apply to adult males employed as engineers, firemen or millers, or as attendants of such workers. Hours of employment.

No woman or young person shall be employed in the factory in any capacity for more than 46 hours in any week.

16. A person or persons shall be appointed who shall see to the observance of the regulations. The names of the persons so appointed shall be recorded in the register. Observance of Regulations.

The persons so appointed shall record in the register once in each week the prescribed details in regard to the prescribed questions concerning the observance of the regulations.

Copies of the prescribed questions and the weekly entries shall be published each week by affixing them in a prominent place in the factory as well as in the mess-room.

17. (3) The occupier shall allow any of His Majesty's Inspectors of Factories to take at any time sufficient samples for analysis of any material in use or mixed for use. Samples for analysis.

Provided that the occupier may at the time when the sample is taken, and on providing the necessary appliances, require the Inspector to take, seal, and deliver to him a duplicate sample.

But no analytical result shall be disclosed or published in any way except such as shall be necessary to establish a breach of these regulations.

PART II.

Duties of Persons Employed.

Periodical examination.

18. (16) All persons employed shall present themselves at the appointed times for examination by the Surgeon as provided in Regulation 2.

No person after suspension shall work without a certificate of permission to work.

Overalls.

19. (17) All persons employed shall, when at work, wear overalls and head-coverings, as required by Regulation 4. The said overalls and head-coverings shall not be worn outside the factory or workshop, and shall not be removed therefrom except for the purpose of being washed or repaired. No overalls or head-coverings, provided in pursuance of Regulation 4, shall, under any circumstances, be taken to a worker's home.

The head-coverings provided in accordance with Regulation 4 shall be worn in such a manner as effectually to protect the hair from dust, and the hair must be so arranged as to permit of this.

The overalls and head-coverings, when not being worn, and clothing put off during working hours, shall be deposited in the respective places provided by the occupier for such purposes under these regulations.

Respirators shall be worn as required by Regulation 8.

Food.

20. (18) No person shall introduce, keep, prepare or partake of any food, drink, or tobacco, or remain during meal-times in any workplace.

Every worker for whom milk or cocoa is provided in accordance with Regulation 6 shall drink the same, unless a medical certificate is produced showing cause for exemption from this requirement.

Ventilation. Dust.

21. (19) No person shall in any way interfere, without the knowledge and concurrence of the occupier or manager, with the means and appliances provided by the employers for ventilation, and for the removal of dust.

Washing.

22. (20) No person employed shall leave the works or partake of meals without previously and carefully cleaning and washing his or her hands.

No person employed shall remove or damage the washing basins or conveniences provided under these regulations.

Cleaning of work-places.

23. (20a) The persons appointed by the occupiers shall clean the several floors, work benches, appliances and other objects regularly as prescribed in these regulations.

Avoidance of dust, &c.

24. (20a) Every worker shall so conduct his or her work as to comply strictly with these regulations, and to avoid, as far as practicable, making or scattering dust, dirt, or refuse, or causing accumulation of such.

REPORT

OF THE

DEPARTMENTAL COMMITTEE

APPOINTED TO INQUIRE INTO

THE DANGERS ATTENDANT ON THE USE OF

LEAD

AND

THE DANGER OR INJURY TO HEALTH ARISING FROM

DUST AND OTHER CAUSES

IN THE MANUFACTURE OF

EARTHENWARE AND CHINA

And in the Processes incidental thereto,

INCLUDING THE MAKING OF LITHOGRAPHIC TRANSFERS.

VOL. II.—APPENDICES.

Presented to both Houses of Parliament by Command of His Majesty.

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APPENDICES.

LIST OF APPENDICES.

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APPENDIX I.

HISTORICAL SUMMARY SHOWING PROGRESS OF FACTORY LEGISLATION, AS APPLIED TO POTTERIES.

Compiled by the Secretary from official and other records.

Earliest Factory Acts.

The earliest Act of Parliament designed to regulate employment in factories was passed in 1802, but this, and all amending Acts for more than sixty years thereafter, were confined in their application to the textile trades.

First Act applying to Potteries, 1864.

In the year 1862 a Royal Commission was appointed to inquire into the employment of children, young persons, and women generally; the deliberations of this Commission resulted in the passing of the Factory Act of 1864, which for the first time extended the system of inspection so as to embrace earthenware works, defined as "Any place in which persons work for hire in making or assisting in making, finishing or assisting in finishing earthenware of any description."

Provisions of the Act of 1864.

The general provisions then (1864) for the first time imposed on earthenware works, included:—

- Periodical limewashing;
- Provision for admission of fresh air;
- Limitation of hours of labour of children, young persons, and women—maximum period substantially the same as at present, viz., twelve hours less meal-times;
- Inspection by Factory Inspectors;
- Fencing of machinery.

Special Rules under the Act of 1864.

In addition to bringing earthenware works under the above general provisions, the Act of 1864 also introduced a class of special rules "for compelling the observance of the conditions necessary to insure the required degree of cleanliness and ventilation." Section 5 of the Act in question gave to each employer the power to propose a code of special rules for his own works; these rules had to be submitted to the Secretary of State for approval; after being amended where needful, they were formally approved, and became operative in the factory in question. This form of legislation imposed duties on the workers, without corresponding duties of occupiers, and many of the leading firms propounded special rules. The following specimen code is quite typical of those sanctioned under the Act of 1864:—

SPECIAL RULES.

Framed under the authority of the 27th and 28th Vict., Cap. 48, for the due cleanliness and ventilation of earthenware manufactories.

1. The measures taken by the employers for the ventilation of the various workrooms shall not be in any way interfered with by the workpeople without the knowledge and concurrence of the manager over the said works.

2. The various rooms in which the flat-pressers, hollow-ware pressers, throwers, turners, and moulders are employed, shall be sprinkled and swept out every day by each workman in turn (or by his substitute), and all the other workrooms, except those for storage only, shall be swept out and cleansed at least once a week, by such workers employed therein as the manager shall depute to this duty. Each bench shall be washed down and cleansed once a week at least by the person usually employed at it.

3. In the saggar-houses the floors shall be properly swept and sprinkled after every setting-in of an oven.

4. The steps and stairs up to and in the various workshops shall be scraped clean and swept at least once a week by one of the workers in such workrooms, deputed to this duty by the manager of the department to which such workshops belong.

5. In every other arrangement for the general cleanliness of any factory, the person deputed by the employer to discharge any duty required of him or her for this purpose, and failing therein, shall be held responsibile for such failure.

6. Smoking in the workrooms during working hours is prohibited.

7. Dogs are forbidden to be brought on the premises by the workpeople.

8. On any violation of these special rules all the workers within any room in which such violation has taken place shall be responsible for every offence, unless previously to the infliction of any penalty for such offence the real offender has been discovered.

The penalty for every breach of the above rules shall not be less than one shilling, and not more than five shillings.

Approved of and adopted by us

(Signed) .... (Signature of manufacturer)
.... (Name of works)
.... (Where situate)

(Signed)........................
Inspector of factories for the district in which the above-mentioned works are situated.

Dated.................... 1864.

Age Limit for Children.

The minimum age at which children might be employed in factories was eight years in 1864; this age limit was raised to nine during the year 1875, and to ten years after 1875.

Little Change from 1864 to 1878.

With the exception of these amendments in the age limit below which children could not be employed, and one or two alterations in minor details, the law governing earthenware works remained unchanged until the passing of the consolidating Factory Act of 1878. This Act repealed all previous Statutes relating to employment in Factories and Workshops.

Provisions of the Act of 1878.

The Act of 1878 re-enacted provisions for limewashing; for limitation of hours of labour of children, young persons and women; for inspection; for fencing of machinery, etc. It also included sections dealing with cleanliness, dust and ventilation. Thus Section 3 required that "A factory shall be kept in a cleanly state . . ." "Shall be ventilated in such a manner as to render harmless, as far as practicable, all the gases, vapours, dust, or other impurities generated in the course of the manufacturing process or handicraft carried on therein that may be injurious to health."

Section 36 read: "Where dust is generated and inhaled by the workers to an injurious extent, if it appears to an inspector that such inhalation could be to a great extent prevented by the use of a fan or other mechanical means, the inspector may direct a fan . . . to be provided within a reasonable time."

Section 39 of this Act, moreover, prohibited children, young persons, and women from taking a meal or remaining during meal-times in certain dangerous places, which included dipping houses, dippers' drying rooms, and china scouring rooms in potteries; this prohibition was extended to majolica painting rooms by an Order of the Secretary of State dated 22nd December, 1882.

Special Rules abandoned in 1878.

The machinery for making special rules as provided in the 1864 Act was not, however, re-enacted. This form of special legislation for particular trades or for particular factories fell, therefore, into abeyance in 1878, and remained so for thirteen years.

Act of 1891 inaugurating Special Rules for Certified Dangerous Trades.

In 1891 a Factory Bill was introduced in Parliament, to give to the Secretary of State power to make special rules for certain dangerous trades. In its original form this Bill was not so framed that the earthenware industry could have been included within its scope; but the pottery workers took the opportunity of calling attention to the dangers of their employ-

ment. This agitation led to important amendments being incorporated in the measure, and the Factory Act of 1891, in the form in which it was finally passed, gave power to the Secretary of State to certify any process carried on in a factory or workshop, as in his opinion dangerous or injurious to health; following on such a certificate, the Chief Inspector of Factories was empowered to serve on the occupiers of any factories or workshops in which the process named was carried on, notice in writing proposing such special rules as appeared to him to be reasonably practicable, and to meet the necessities of the case. If no objection were notified within twenty-one days, the special rules were established and became operative in those factories on the occupiers of which they had been served. If objections were notified and not withdrawn in view of a compromise or other settlement, the matters in dispute were required to be put to arbitration.

Method of Arbitration.

The method of conducting arbitrations arising out of objections to proposed special rules is prescribed in the first Schedule of the Act of 1891. The principal provisions of this Schedule are as follows:—

1. The parties to the arbitration are deemed to be the occupiers of the factory or workshop on the one hand, and the chief inspector, on behalf of the Secretary of State, on the other.

2. Each party may appoint an arbitrator within fourteen days after the date of the reference.

3. If within the said fourteen days either of the parties fails to appoint an arbitrator, the arbitrator appointed by the other party may proceed to hear and determine the matter in difference, and in that case the award of the single arbitrator shall be final.

4. The arbitrators shall appoint an umpire to decide on points on which they may differ.

5. The decision of the umpire on matters referred to him shall be final.

6. The arbitrators and the umpire, or any of them, may examine the parties and their witnesses on oath, and may also consult any counsel, engineer, or scientific person whom they may think it expedient to consult.

Inquiry by Mr. Cramp, 1892.

Before the Secretary of State certified the manufacture of earthenware to be a dangerous trade, an inquiry into the conditions of work in the Staffordshire Potteries was conducted by Mr. (now Sir William) Cramp, who was at that time His Majesty's Superintending Inspector of Factories for the Midland Division. This inquiry was completed in the course of the year 1892, and copies of his report were sent to manufacturers in the potting industry, in November, 1892. In that report many recommendations were made; and a code of special rules were advocated, of which the following was the draft:—

Draft Rules Proposed by Mr. Cramp in 1892.

Rule 1.—They shall not allow any child under 14 to be employed in the dipping-house, dippers' drying room, or in the processes of ware-cleaning after the dippers, glost-placing, china-scouring, ground-laying, or majolica-painting, or in any process in which lead is used.

Rule 2.—They shall provide suitable overalls and head-coverings for all workers employed in the places and processes referred to in No. 1.

Rule 3.—They shall not allow any person (adult males included) to have any meal or to remain during mealtimes in the dipping-house, dippers' drying room, china scouring room or majolica painting room.

Rule 4.—They shall adopt measures in all dusty processes for the removal of all superfluous dust, either by the use of mechanical fans or other efficient means.

Rule 5.—They shall provide brooms, brushes, and all other necessaries for the daily sweeping of floors of shops, and of such stoves as are entered by the workers, and for the cleansing of work benches and shelves, and of stairs leading to workshops, and shall arrange that all workrooms are sprinkled and swept out every day, and the scraps and dirt removed, and that all work-benches and shelves (not used for storage) and stairs are washed down and cleansed at least once a week.

Rule 6.—They shall provide washing conveniences, with a sufficient supply of water, soap, nail brushes, and towels, for all workers employed in the places and processes referred to in No. 1.

Rule 7.—Omitted.

Rule 8.—Every person to whom is supplied an overall suit or head-covering shall wear the same when at the special work for which such are provided.

Rule 9.—Every person employed in dipping, carrying ware from the dipper, cleaning ware after it has been dipped, glost-placing, ground-laying, or majolica painting, shall carefully clean and wash hands and face before meals and before leaving the works.

Rule 10.—Every person employed in the processes referred to in No. 9 shall, during meal times, leave the shops in which those processes are carried on, and shall not cook or eat any food therein at any time.

Rule 11.—The measures taken by the employers for the ventilation of the various workrooms and stoves, and for the removal of dust, shall not be in any way interfered with by the workpeople, without the knowledge and concurrence of the employer or manager of the works.

Rule 12.—Every male or female worker over 18 years of age employed in any shop in which clay—whether in moist or dry state—is used, and in the printing and painting shops, shall be responsible for the cleansing of that portion of the room which he or she occupies, and shall see that the floors of shops, and of such stoves as are entered by the workers, are sprinkled and swept, and the dust, scraps, ashes and dirt removed every day, and that the work-benches and the shelves not used for storage are washed down and cleansed at least once a week.

Manufacture of Earthenware certified a Dangerous Trade.

On the 24th December, 1892, Mr. H. H. Asquith, then Secretary of State for the Home Department, certified the manufacture of earthenware to be, in his opinion, a dangerous trade within the meaning of Section 8 of the Factory and Workshop Act, 1891.

Operatives' Comments on Mr. Cramp's Report.

On January 16th, 1893, the Representative Committee of the Operative Potters wrote as follows:—
". . . . We thoroughly agree with most of Mr. Cramp's conclusions upon the unhealthy conditions of labour in our trade; but we do not think the Special Rules suggested by him provide for such a complete protection of the working potters, as we believe to be practicable and necessary in such an admittedly dangerous and life-shortening occupation. . . We therefore recommend, and after consulting and receiving the instructions of the rank and file of working potters, appeal to your Department, that the following be made Special Rules for the purpose of lessening the evils of dust, and also to ensure adequate ventilation on the best principles:—

Draft Rules suggested by Operatives, January, 1893.

1. All dusty processes such as towing, scouring, and cleaning of ware, and sandpapering of moulds by young persons, women, or men, shall only be performed under such conditions, and in connection with such mechanical appliances as will effectually carry away all dust so generated, without the same coming in contact with the breathing organs of the workers, and no workers in any such processes shall be allowed to blow with their mouths, the dust off any article of pottery.

2. The factory inspector for the district shall be empowered to select the best and most effective system of fan ventilation for the purposes defined in rule 1, and also for the removal of dust from all shops in which flat-pressers, jiggerers, hollow-ware pressers, turners, etc., are employed, and such fan ventilation shall be adequate to the inlet of the necessary fresh air, without causing draughts, and for the drawing out of the vitiated air.

3. Where dust injurious to the workers is generated in any process, and such dust cannot be carried away by any known mechanical contrivance or fan, the workers in such processes shall be provided with

respirators, and such workers, when so provided with respirators, shall be liable to a penalty under the Act if they do not wear them while pursuing their labour, or that part of it in which dust is generated, and liable to be inhaled to the injury of their health.

4. To prevent overcrowding, the number of work-people allowed in each workshop shall be proportioned and limited to such cubic space in such workshop as sanitary science has defined as being of sufficient capacity for maintaining the health of the workers therein: and further, neither men nor women shall be allowed to work at narrow benches face to face with each other.

5. Adopts Rule 5 as suggested by Mr. Cramp, and then adds to it as follows:—"Such daily sweeping and cleaning shall be done by a male adult, appointed by and responsible to the occupier, and shall in all cases be performed after the whole of the workers have finished their work for the day in the shop where the cleansing is taking place. The occupier shall be empowered to levy such a charge per adult male and female worker as will be adequate, and no more, for paying the wages of such male adult sweeper."

6. They shall not allow towing and all such specially dusty processes to be performed, except in separate workshops.

7. All moulds not in use shall be stored in a separate room, not used as a workshop; and all "boards" that have been used for the purpose of drying pottery ware after it has been dipped by the dipper, shall not be allowed to be used by other workers unless such boards have been properly cleansed from the dry glaze, as the present use of such uncleansed boards is a cause of dangerous dust being inhaled.

8. That all workers in any process in which dust is generated, such as towing, have suitable overalls and head-coverings provided for them.

9. No workshop shall be heated to a greater maximum degree than 70.

10. Steam shall be applied for drying and heating purposes in such a manner as to enable the worker to so regulate the incoming of steam in the heating pipes as to prevent excessive heat in his stove or shop; and, further, no exhaust steam pipes be allowed to be fixed near the doors or windows of any workshop.

11. No ovenman shall be allowed to enter any potter's oven, for the purpose of drawing out the ware after firing, which registers more than 115 degrees of heat.

Operatives' Recommendations with regard to Risk of Lead Poisoning.

1. No raw lead shall be used in the composition of any glaze for eathenware and china.

2. No one shall be allowed to perform the dangerous operation of "dipping" ware that has not attained the age of 21 years; and all workers in this department shall undergo a medical examination at least once in three months. No child shall be employed in the dipping-house, etc., who is under 16 years of age.

3. The fumes arising from dipping tubs shall be carried off by means of shafts or funnels over or sufficiently near the tubs, such shafts having a drawing power through the operation of a fan.

Operatives' Recommendations with regard to Ovens.

1. To facilitate the cooling of ovens, all such ovens erected in future shall have top cooling dampers on.

2. To prevent the draughts caused in saggar houses through the cooling of ovens, as far as possible back "clammings" shall be put in all ovens for cooling purposes.

Operatives' Recommendations with regard to the Making of Moulds.

1. The box containing the plaster shall be at such a distance from the mould-maker's bench, that the dust arising therefrom may not be inhaled while he is working at the bench.

2. In workshops where two or more mould makers are employed, and work out of the same plaster-box, there shall be a funnel over the box to draw off the dust.

Manufacturers' Criticisms of Draft Rules proposed by Mr. Cramp.

On January 20th, 1893, Mr. A. P. Llewellyn, Secretary of the North Staffordshire Chamber of Commerce, forwarded a letter embodying the conclusions arrived at by a Joint Committee of the Chamber of Commerce, the Staffordshire Potteries Manufacturers' Association, and the Plain Decorative Encaustic and Earthenware Tile Manufacturers' Association.

This Joint Committee desired to protest, in the first place, against the industry having been certified as a dangerous trade, on what appeared to them to be *ex parte* statements. The letter continues:—"With reference to lead-fritting in the glaze, this matter has been carefully considered by the Committee, but up to the present they have not found there is any satisfactory proof or conclusive evidence to show that fritting the lead would remove the evils of using it, but the Committee understand manufacturers are making careful experiments to see how far it is possible, without damaging the reputation of the Staffordshire ware, to frit the lead, and they feel strongly that any legislation on the subject would be premature and most undesirable, and, if pressed, would run a serious risk of entirely destroying the trade of the district."

As to special rules proposed, Mr. Llewellyn continues:—

Rule No. 1.—The Committee approve of this rule.

Rule No. 2.—The Committee are fully alive to the advisability of persons employed in places and processes referred to in the previous rule wearing overalls and head-coverings, and in most works they generally do so, but manufacturers are of opinion that considering the higher wages paid to most of these branches, the operatives should be required to provide such articles themselves, in accordance with the practice hitherto adopted.

Rule No. 3.—The Committee are anxious that this rule should be carried out, but suggest the addition of the following words at the end of it: "but that a notice affixed in these places shall be a sufficient proof of manufacturers' compliance with this rule."

Rule No. 4.—In place of this rule the Committee take the liberty of suggesting the following:—

Proposed Rule No. 4.—In all towing and china scouring shops they shall adopt measures for dealing with all superfluous dust, and for the prevention of any injurious effects arising therefrom, either by the use of mechanical fans, respirators, or other efficient means.

Rule No. 5.—The Committee approve of this rule, but suggest the elimination therefrom of the words "and shelves" in the third line, and the words "and shelves (not used for storage)" and "washed down and" in the sixth line.

Rule No. 6.—The Committee approve of this rule, but experience has shown manufacturers that the workpeople do not avail themselves of the convenience where it is already provided, and as manufacturers find that soap, nail-brushes, and towels disappear as rapidly as provided, they suggest the alteration of the rule in this particular, by the withdrawal from it of the manufacturers' liability to provide the articles in question.

Rule No. 8.—The Committee approve of this rule, but have altered it slightly, as shown below, in view of the previous remarks:—

Proposed Rule No. 8.—Every person employed in the places and processes referred to in Rule No. 1 shall provide an overall suit or head-covering, and shall wear the same when at the special work for which such are provided.

Rules Nos. 9, 10 & 11.—The Committee approve of these rules.

Rule No. 12.—The Committee approve of this rule as set out below:—

Proposed Rule No. 12.—Every male or female worker shall be responsible for the cleansing of that portion of the room which he or she occupies, and shall see that the floors of shops and of such stoves as are entered by the workers are sprinkled and swept, and the dust, scraps, ashes, and dirt removed every day, and that the work-benches are cleansed at least once a week.

Manufacturers' Criticisms of Draft Rules proposed by Operatives.

In a further letter, dated February 10th, 1893, Mr. Llewellyn forwards the following comments of the Joint Committee on the operatives' proposals, as set forth in their letter of 16th January, 1893:—

Rule No. 1.—The Committee feel that this rule, if passed as proposed by the operatives, would be perfectly unworkable in practice; and, further than this, the Committee would point out that on those manufactories where fans, according to the inspector of factories, are working satisfactorily, the workers *do* blow off the dust with their mouths. The Committee therefore adhere to their suggestion of the 20th ultimo, under the heading of Rule 4.

Rule No. 2.—The Committee object to this suggested rule as imposing upon factory inspectors duties which do not belong to them, and of which they have no special knowledge, and, further than this, the Committee object to the inclusion in it of processes which cannot be called dusty.

Rule No. 3.—Whilst the Committee are quite willing, as indicated in their proposed Rule No. 4, to provide respirators where fans are found impracticable, they feel it is carrying matters too far to fine workers who will not wear them.

Rule No. 4.—The Committee understand manufacturers have no objection to their workmen being allotted sufficient cubic space in the workrooms, in accordance with sanitary requirements, but they consider it would be absurd to lay down any regulation as to the position in which work-benches should be placed.

Rule No. 5.—The Committee are of opinion that the special rules numbered 5 and 12, as suggested by Mr. Cramp, and slightly altered by them, protect the workpeople in every way, and, furthermore, the Committee think that each manufacturer should be left to see that such rules are carried out in the way most agreeable to him.

Rule No. 6.—The Committee see no objection to this rule if it were altered to read as follows:—"They shall not allow towing to be performed, except in separate workshops, unless a fan is provided."

Rule No. 7.—The Committee strongly object to the first part of this rule, and with regard to the use of dipper's boards by other operatives, the Committee understand manufacturers would be quite willing to issue notices to their workpeople that boards used in the dipping-house must not be taken away or used for any other purpose; providing that the posting of this notice shall be considered as a sufficient compliance with the rule on the manufacturers' behalf.

Rule No. 8.—The Committee would refer you to their remarks under the heading of Rule No. 2, as contained in their previous letter.

Rule No. 9.—The Committee object to this rule, as the regulation of the temperature by ventilation is a matter largely within the control of the workpeople themselves.

Rule No. 10.—The Committee also object to this rule as being impracticable, as the interference (or right to interfere) with the steam pipes by unauthorised individual workpeople would entirely prevent manufacturers having the proper regulation of their works, and would tend greatly to remove the present economy of working.

Rule No. 11.—The Committee consider this rule unnecessary, as it is not in the interests of manufacturers to draw hot ovens, and from the fact that there is no compulsion on any workman to enter ovens until they are fit to be drawn.

As to the other matters contained in the operatives' letter, in which they press for special rules to be sanctioned by your department:—

(1) With regard to no raw lead being used in the composition of any glaze for earthenware and china, the Committee would again specially draw your attention to their remarks with reference to lead-fritting as set out in their previous communication;

(2) As to no one being allowed to become a dipper until he has attained the age of 21 years, &c., the Committee object to this, as they would point out that this age-limit would tend largely to do away with all apprentices, and as to children employed in the dipping-houses, &c., they consider the age of 14, as mentioned in Mr. Cramp's report, more in accordance with reason;

(3) As to the fumes arising from dipping-tubs, the Committee are at a loss to understand to what fumes the operatives refer;

(4) As to all future ovens erected having top cooling dampers on, the Committee have dealt with this by their previous remarks (see Rule 11);

(5) As to back clammings to ovens, the Committee object to this as being impracticable;

(6) As to the mould-maker's box of plaster being at a proper distance from the bench to prevent him inhaling the dust, the Committee understand this is already done;

(7) As to a funnel being placed over the plaster-box where two or more mould-makers are employed, the Committee object to this as being unnecessary.

Committee of 1893.

On 21st April, 1893, a Committee was appointed by Mr. H. H. Asquith "to make inquiry into the conditions under which the manufacture of pottery is carried on, with the object of diminishing any proved ill effects on the health of the workpeople engaged therein."

The Committee consisted of:—

Sam W. May, Esq., H.M. Superintending Inspector of Factories (Chairman).

John T. Arlidge, Esq., M.D. and A.B. (Lond.), F.R.C.P. (Lond.).

W. Dunnett Spanton, Esq., F.R.C.S.E.

A. P. Laurie, Esq., M.A., B.Sc., F.R.S.E., Fellow of King's College, Cambridge, Gilchrist Lecturer.

J. H. Walmsley, Esq., H.M. Inspector of Factories.

W. Dawkins Cramp, Esq., H.M. Superintending Inspector of Factories (Secretary).

This Committee reported in July, 1893*; practically all their recommendations were incorporated in the Draft Rules issued by the Home Office in December, 1893.

Draft Rules of December, 1893.

1. They shall provide suitable overalls and head-coverings for all workers employed in the dipping-house or dippers' drying room, or in any process of ware cleaning after the dipper, glost placing, china scouring, ground laying, or majolica painting, or in any process in which lead is used, and shall have the said articles washed on the premises, and shall also provide a place in which the workers can deposit clothing put off during working hours.

2. They shall not allow any persons (either adult males or others) to cook or partake of any food, or to remain during mealtimes in the dipping-house, dippers' drying room, china scouring room, glost placers' shop, ground-laying shop or majolica painting room.

3. They shall adopt efficient measures in the processes of towing of earthenware and of the scouring of china, for the removal of all dust and flint by fans or other mechanical means; and in all dusty processes they shall adopt measures for dealing with avoidable dust, and for the preventing of any injurious effects arising therefrom, either by the use of mechanical fans or other efficient means.

4. They shall provide brooms, brushes, and all other necessaries for the daily sweeping of floors of workshops and of such stoves as are entered by the workers, and for the cleansing of work-benches and of stairs leading to workshops; and shall arrange that the floors of such workshops and stoves are sprinkled and swept every working day, and the scraps and dirt removed, and that work-benches and stairs are cleansed at least once a week. The daily sweeping of floors of potters' shops shall be done after work has ceased for the day, unless there is some sufficient reason to the contrary.

5. They shall provide washing conveniences with a sufficient supply of water, soap, nail-brushes, and towels for all workers employed in the places and

* Report of Potteries Committee, 1893, C. 7240.

process referred to in Rule 1; and the washing apparatus shall be in convenient proximity to the work places.

6. They shall arrange that the temperature of potters' workshops outside the drying stoves, when people are working there, shall not exceed 80° Fah. if the outside temperature is below 70° Fah., and when the temperature outside is above 70° Fah. the inside temperature shall not be more than 10° higher.

7. Every person to whom is supplied an overall suit or head covering shall wear the same when at the special work for which such are provided.

8. Every person employed in the places or processes enumerated in Rule 1 shall carefully clean and wash his or her hands and face before meals and before leaving the works.

9. Every person employed in dipping, carrying ware from the dipper, cleaning ware after it has been dipped, glost placing, china scouring, ground laying, majolica painting, or in any process in which lead is used, shall, during the meal-times, leave the shops in which those processes are carried on, and shall not cook or eat any food therein at any time.

10. The measures taken by the employers for the ventilation of the various workrooms and stoves, and for the removal of dust, shall not be in any way interfered with by the workpeople without the knowledge and concurrence of the employer or manager of the works.

11. Every male or female worker shall be responsible for the cleansing of that portion of the room in which he or she is employed, and shall see that the floors of shops and of such stoves as are entered by the workers are sprinkled and swept, and the dust, scraps, ashes, and dirt removed every day, and that the work-benches and stairs are cleansed at least once a week. The sweeping of floors of potters' shops shall be done after working hours, either by themselves (*i.e.*, the workers) or by an adult male employed and paid by them and approved by the employer.

Objections to Draft Rules of 1893.

In the form of objection drawn up by the Manufacturers' Association in January, 1894, the employers rejected the Temperature Rule (No. 6) *in toto*; they sought to lay the onus of providing and maintaining overalls entirely on the workers by substituting for Rule 1 (Duties of Occupiers):—

1. They shall require all workers employed in the dipping-house or dipper's drying-room, or in any process of ware cleaning after the dipper, china scouring, ground laying, or majolica painting, to wear suitable overalls and head-coverings;

and for Rule 7 (Duties of Persons Employed):—

7. Every person shall provide and wear an overall suit or head-covering when at the special work mentioned in Rule 1 (as modified).

They suggested, also, to omit all reference to "glost placing" and to "any other process in which lead is used," not only in connection with the overall rule as above, but also in relation to the prohibition of food and exclusion during meal-times, thus:—

2 (suggested). They shall not allow any persons (either adult males or others) to cook or partake of any food, or to remain during meal-times in the dipping-house, dipper's drying-room, china-scouring room, ground-laying shop, or majolica-painting room.

9 (suggested). Every person employed in dipping, carrying ware from the dipper, cleaning ware after it has been dipped, china scouring, ground laying, and majolica painting, shall, during the meal-times, leave the shops in which those processes are carried on, and shall not cook or eat any food therein at any time.

Rules 3 and 5 the manufacturers desired to modify as follows:—

3. In all towing and china-scouring shops they shall adopt measures for dealing with all superfluous dust, and for the prevention of any injurious effects arising therefrom, either by the use of mechanical fans, respirators, or other efficient means;

5. They shall provide washing conveniences with a sufficient supply of water, for all workers employed in the places and processes referred to in Rule 1 (as modified).

Rule 4 was the only rule dealing with duties of occupiers which was approved by the manufacturers, but they accepted also Rules 8, 10, and 11 (Duties of Persons Employed).

Inquiry by H.M. Superintending Inspectors.

Mr. Cramp and Mr. May, H.M. Superintending Inspectors of Factories, were instructed to investigate the objections; they reported, in February, 1894, that their negotiations with the manufacturers had resulted in the narrowing down of the points at issue to practically two only, viz.:—

1. Provision of overalls.
2. Temperature clause.

Conference at Stoke, April, 1894.

A formal conference, presided over by Mr. G. W. E. Russell, who was at that time Under-Secretary of State for the Home Department, was held at Stoke-on-Trent in April, 1894; a compromise was then effected on the disputed points; and the rules of 1894 were finally accepted in the form set out below:—

SPECIAL RULES ESTABLISHED IN 1894.

Duties of Occupiers.

1. They shall provide suitable overalls and head-coverings for all female workers employed in the dipping-house or dippers' drying-room, or in any processes of ware cleaning after the dipper, glost placing, china scouring, ground laying or majolica painting (which overalls and head-coverings shall remain the property of the employers) and shall make arrangements for the safe custody of all overalls and head-coverings worn by their operatives and for the safe delivery thereof at the works every seven days to the representatives of the laundry or wash-house which shall be selected by the operatives for the purpose of washing the same. They shall also provide a place in which the above workers can deposit clothing put off during working hours.

2. They shall not allow any person to cook or partake of any food, or to remain during meal-times in the dipping-house, dippers' drying-room, china-scouring room, glost-placers' shop, ground-laying shop, or majolica-painting room.

3. In the process of towing of earthenware, they shall use fans or other mechanical means for the removal of all dust; in the process of scouring china, they shall, as far as practicable, use mechanical or other efficient means for the removal of flint; and, in all processes and descriptions of manual labour, they shall, as far as practicable, adopt measures for the removal of dust, and for the prevention of any injurious effects arising therefrom, either by the use of mechanical fans, ventilation, or other efficient means.

4. They shall provide brooms, brushes, and all other necessaries for the daily sweeping of floors of workshops and of such stoves as are entered by the workers; and for the cleansing of work-benches and of stairs leading to workshops; and shall arrange that the floors of such workshops and stoves are sprinkled and swept every working day, and the scraps and dirt removed, and that work-benches and stairs are cleansed at least once a week. The daily sweeping of floors of potters' shops shall be done after work has ceased for the day, unless there is some sufficient reason to the contrary.

5. They shall provide washing conveniences and a sufficient supply of water, soap, and nail-brushes for all workers employed in the dipping-house or dippers' drying-room, or in any processes of ware cleaning after the dipper, glost placing, china scouring, ground laying, or majolica painting as close as is practicable to the workshops.

6. All stoves, as well as all workshops and all parts of the factories, shall be effectually ventilated. Regard being had to the cubic capacity of the shops, &c., there shall be, wherever practicable, natural ventilation by doors and windows; and careful supervision of hot air and hot water pipes used for heating, and of the consumption of gas. The required ventilation shall be accomplished by mechanical or other efficient means. The temperature of any workshop during working hours shall not be allowed to exceed 90° Fah.

Duties of Persons Employed.

7. Every person employed in the places and processes enumerated in Rule 1 shall wear an overall suit or head-covering when at their work and no such person shall remove such overall suit or head-covering from the works at which they are employed so long as they shall continue in such employ.

8. Every person employed in the places or processes enumerated in Rule 5 shall carefully clean and wash his or her hands and face before meals and before leaving the works.

9. Every person employed in dipping, carrying ware from the dipper, cleaning ware after it has been dipped, glost placing, china scouring, ground laying or majolica painting, shall, during the meal-times leave the shops in which those processes are carried on, and shall not cook or eat any food therein at any time.

10. The measures taken by the employers for the ventilation of the various workrooms and stoves, and for the removal of dust, shall not be in any way interfered with by the workpeople without the knowledge and concurrence of the employer or manager of the works.

11. Every male or female worker shall be responsible for the cleansing of that portion of the room in which he or she is employed, and shall see that the floors of shops and of such stoves as are entered by the workers, are sprinkled and swept, and the dust, scraps, ashes, and dirt be removed every day, and that the work-benches and stairs are cleansed at least once a week. The sweeping of floors and of potters' shops shall be done after the working hours, unless there is some sufficient reason to the contrary, by an adult male, employed and paid by the workers and approved by the employer.

Act of 1895.

The above rules remained in force four years (1894 to 1898), but in the meantime the Factory Act of 1895 was passed.

Representation of Workmen at Arbitrations.
Restrictions of Dangerous Employment.

The new Act did not repeal the Act of 1891, but amplified its provisions by definitely providing for the representation of workmen at arbitration proceedings concerning special rules; also by authorising the making of special rules "prohibiting the employment of, or modifying, or limiting the period of employment for all or any classes of persons" in any process certified to be dangerous. This Act, moreover, included for the first time a general requirement to provide washing conveniences for persons employed in any department where lead, arsenic, or other poisonous substance is used.

Notification of Lead Poisoning, &c.

The Act of 1895 also introduced compulsory notification by medical practitioners of all cases of industrial lead poisoning coming under their notice. Thus, statistics of lead poisoning in potteries were not collected until 1896.

Effect of 1894 Rules.

It was generally assumed that the 1894 Rules were effecting a reduction in the number of cases of lead poisoning, but in 1896 to 1898 the number of cases in North Staffordshire alone was as follows:—

Year.	No. of cases of lead poisoning.	Attack rate per 1,000. (No. of lead workers in North Staffs Potteries = 4,700 approx.)
1896	351	75
1897	386	82
1898	348	74

First Amendment of Code.

It soon became apparent that the code of 1894 must be regarded as having served its purpose as an experimental measure, and that the time had come for replacing it by a more complete set of rules.

Fresh Certificate by the Secretary of State.

The original certificate declaring the manufacture of earthenware to be, in the opinion of the Secretary of State, a dangerous trade, was replaced by an amended certificate dated 7th May, 1898, whereby "the manufacture and decoration of earthenware and china" were certified as dangerous within the meaning of Section 8 of the Act of 1891.

Following on this, an amended set of rules, known as the Code of May, 1898, was served on 576 manufacturers, at that time comprised in the Home Office list of pottery manufacturers.

SPECIAL RULES OF MAY, 1898.

Duties of Occupiers.

1. *Age.*—After August 1st, 1898, no person under 14 years of age, and after August 1st, 1899, no person under 15 years of age, shall be employed in the
   Dipping house, or
   Dippers' drying room,

or in any processes of—
   Ware cleaning after the dipper,
   Glost placing,
   Colour dusting,
   Ground laying,
   Majolica painting,
   Glaze blowing,
   Transfer making, or
   China scouring.

2. *Monthly Examination.*—All women and young persons employed in the places and processes named in Rule 1 shall be examined once a month by the Certifying Surgeon for the District, who shall after August 1st, 1898, have power to order suspension from employment in any place or process named in Rule 1.

No person after such suspension shall be allowed to work in any of the places or processes named in Rule 1 without the written sanction of the certifying surgeon.

3. *Health Register.*—A register, in the form which has been prescribed by the Secretary of State for use in earthenware and china works, shall be kept, and in it the certifying surgeon will enter the dates and results of his visits, the number of persons examined, and particulars of any directions given by him. This register shall contain a list of all persons employed in the places and processes named in Rule 1, and shall be produced at any time when required by H.M. inspector of factories or by the certifying surgeon.

4. *Overalls and Head coverings.*—The occupier shall provide and maintain suitable overalls and head coverings for all women and young persons employed in the places and processes named in Rule 1.

All overalls and head coverings shall be kept in proper custody and all overalls shall be washed at least once a week, and suitable arrangements shall be made for carrying out these requirements.

A suitable place shall be provided in which the above workers can deposit clothing put off during working hours.

5. *Food.*—No person shall be allowed to prepare or partake of any food or drink, or to remain during meal-times in the dipping house or dippers' drying room, or in a place in which is carried on any process named in Rule 1.

The occupier shall make suitable provision to the reasonable satisfaction of the inspector in charge of the district for the accommodation during meal-times of persons employed in such places or processes.

6. *Dust.*—After January 1st, 1899, the process of—
   Towing of earthenware,
   China scouring,
   Ground laying,
   Colour dusting,
   Glaze blowing, or
   Transfer making

shall not be carried on without the use of exhaust fans for the effectual removal of dust.

In the process of ware cleaning after the dipper exhaust fans shall be used, or arrangements made for the dust to fall into water.

In all processes the occupiers shall, as far as practicable, adopt efficient measures for the removal of dust and for the prevention of any injurious effects arising therefrom.

7. *Ventilation.*—All drying stoves as well as all workshops and all parts of factories shall be effectually ventilated to the reasonable satisfaction of the inspector in charge of the district.

8. *Lavatories.*—The occupier shall provide and maintain sufficient and suitable washing conveniences for all persons employed in the places and processes named in Rule 1, as near as is practicable to the places in which such persons are employed.

The washing conveniences shall comprise soap, nail-brushes, and towels, and at least one lavatory basin for every five persons employed as above, and each such basin shall be fitted with waste-pipe, and have a constant supply of water laid on by tap.

9. *Cleansing of Work-places.*—The occupier shall see that the requirements of Rule 16 are duly observed, and shall provide brushes and all other necessaries for the purpose.

10. *Boards.*—The boards used in the dipping house, dippers' drying-room or glost placing shop shall be cleansed every week, and shall not be used in any other department.

Duties of Persons Employed.

11. *Monthly Examination.*—All women and young persons employed in the places and processes named in Rule 1 shall present themselves at the appointed time for examination by the certifying surgeon as provided in Rule 2.

No person after suspension by the certifying surgeon shall work in any of the places or processes named in Rule 1 without the written sanction of the certifying surgeon.

12. *Overalls.*—Every person employed in the places and processes named in Rule 1 shall, when at work, wear an overall suit and head covering, which shall not be worn outside the factory or workshop, and which shall not be removed therefrom except for the purpose of being washed.

The overalls and head coverings, when not being worn, shall be deposited in the place provided for the purpose under Rule 4.

Clothing put off during working hours shall be deposited in the place provided for the purpose under Rule 4.

13. *Food.*—No person shall remain during meal-times in the dipping house, dippers' drying room, or in any place in which is carried on any process named in Rule 1; or prepare or partake of any food or drink therein at any time.

14. *Ventilation. Dust.*—No person shall in any way interfere, without the knowledge and concurrence of the occupier or manager, with the means and appliances provided by the employers for the ventilation of the workshops and stoves and for the removal of dust.

15. *Washing.*—No person employed in any place or process named in Rule 1 shall leave the works or partake of meals without previously and carefully cleaning and washing his or her hands.

16. *Cleansing of Work-places.*—The persons employed shall be responsible for the

daily sprinkling and sweeping of the floors of workshops and of such stoves as are entered by the workpeople; and for the

daily removal of dust, scraps, ashes and dirt; and for the

weekly cleansing of work-benches and of stairs leading to workshops.

Each person shall be responsible for the cleansing of that portion of the room in which he or she is employed.

The sweeping of the floors of potters' shops, stoves, dipping houses, and majolica painting rooms shall be done after working hours, by an adult male, employed and paid by the workers and approved by the employer.

17. *Boards.*—The boards used in the dipping house, dippers' drying room, or glost placing shop shall be cleansed every week, and shall not be used in any other department.

Arbitration on the 1898 Rules.

The above Rules were accepted without objection by 476 out of the 576 pottery firms on whom they were served; the remaining 100 firms, however, objected to certain features in the proposed Code, and an Arbitration was conducted in accordance with the provisions of the Acts of 1891 and 1895, set forth above.

Arbitration of 1898.

Mr. Chester Jones was appointed by the Home Office, as Arbitrator; Mr. Llewellyn was appointed as Arbitrator to represent the objecting firms; and Mr. J. S. Dugdale, Q.C., was appointed as Umpire by the above-named Arbitrators. The award of the Umpire was issued on the 22nd October, 1898. A few of the firms who objected to the May, 1898, Rules did not object to Mr. Chester Jones acting as sole Arbitrator; the result of the arbitration was the same for these firms, however, as for those who nominated Mr. Llewellyn as their Arbitrator; because Mr. Chester Jones, on the 28th October, 1898, signed an award applicable to those firms who had accepted him as sole Arbitrator, in exactly the same terms as the award of the Umpire, Mr. J. S. Dugdale, in the case of the firms who had nominated Mr. Llewellyn. The award Rules read as follows:—

SPECIAL RULES OF OCTOBER, 1898.

*Rules 1, 2, 3, 7, 9, 11 and 13 to 16 the same as in May, 1898, Rules.**

4. The occupier shall provide and maintain suitable overalls and head coverings for all women and young persons employed in the places and processes named in Rule 1.

All overalls and head coverings shall be kept *by the occupier* in proper custody, and shall be washed at least once a week, and suitable arrangements shall be made for carrying out these requirements.

A suitable place shall be provided in which the above workers can deposit clothing put off during working hours.

5. No persons shall be allowed to prepare or partake of any food or drink, or to remain during meal-times, in the dipping house or dippers' drying room or in a place in which is carried on any process named in Rule 1.

The occupier shall make suitable provision to the reasonable satisfaction of the inspector in charge of the district for the accommodation during meal-times of persons employed in such places or processes, *with a right of appeal to the Chief Inspector of Factories. Such accommodation to be provided in any room or rooms on the premises other than those referred to in Rule 13.*

6. After January 1st, 1899, the process of:—

Towing of earthenware,
China scouring,
Ground laying,
Colour dusting,
Glaze blowing, or
Transfer making

shall not be carried on without the use of exhaust fans for the effectual removal of dust, *or other efficient means for the effectual removal of dust, to be approved in each particular case by the Secretary of State, and under such conditions as he may from time to time prescribe.*

In the process of ware cleaning after the dipper, exhaust fans shall be used, or arrangements made for the dust to fall into water.

In all processes the occupiers shall, as far as practicable, adopt efficient measures for the removal of dust and for the prevention of any injurious effects arising therefrom.

8. The occupier shall provide and maintain sufficient and suitable washing conveniences for all persons employed in the places and processes named in Rule 1, as near as is practicable to the places in which such persons are employed.

The washing conveniences shall comprise soap, nail-brushes and towels, and at least one *wash-hand* basin for every five persons employed as above, *with a constant supply of water laid on, with one tap at least for every two basins, and conveniences for emptying the same and running off the waste water on the spot down a waste pipe.*

10. The boards used in the dipping-house, dippers' drying room, or glost placing shop shall be cleansed every week, and shall not be used in any other department, *except after being cleansed.*

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* See pages 8 and 9.

12. Every person employed in the places and processes named in Rule 1 shall, when at work, wear an overall suit and head covering, which shall not be worn outside the factory or workshop, and which shall not be removed therefrom except for the purpose of being washed. *All overalls and head coverings shall be washed at least once a week.*

The overalls and head coverings, when not being worn, shall be deposited in the place provided for the purpose under Rule 4.

Clothing put off during working hours shall be deposited in the place provided for the purpose under Rule 4.

17. The boards used in the dipping house, dippers' drying room, or glost placing shop shall be cleansed every week, and shall not be used in any other department, *except after being cleansed.*

Two Codes in force simultaneously.

The modifications in the Code of May, 1898, which were introduced as a result of the arbitration, are shown in italics above.

It will be noted that the alterations are, on the whole, very slight, but the result of the arbitration in regard to the 100 firms who objected to the May, 1898, Rules, was that they were for the next three years under a Code of Rules slightly different to those in force in the other 476 works.

Effect of 1898 Code.

The effect of the introduction of the two Codes of 1898 Rules (May and October) was very marked, and the number of lead cases fell rapidly:—

Year.	North Staffs alone; No. of Lead Workers = 4,700 (approx.).		Whole of United Kingdom; No. of Lead Workers = 6,700 (approx.).	
	Lead Cases.	Attack rate per 1,000.	Lead Cases.	Attack rate per 1,000.
1899 -	204	42	249	37
1900 -	165	34	200	30
1901 -	84	17	106	16

The provisions to which the good effect of these Rules was mainly ascribed, were:—

1. The monthly medical examination of women and young persons, and

2. The application of exhaust fans to dusty processes.

Effect of Monthly Medical Examination.

The effect of the monthly medical examination is perhaps best shown by considering the proportion of female cases in the total lead cases of each year, because adult males were not included in the medical examination rule, but probably benefited to about the same extent as the females, from the improvement in general conditions:—

	Average.
1896-8	53·9
1899-01	49·2

Effect of introducing Exhaust Fans.

Under these rules, it became compulsory to provide a fan or other contrivance which would set up a current of air flowing away from the worker engaged on certain lead processes, in such a manner as to carry away with it any dust generated in the operation; the improvement effected by local exhaust ventilation is best illustrated by contrasting the number of lead poisoning cases arising in certain special processes, such as ground laying, before and after the introduction of this means of removing dust; in the case of ground laying in the North Staffordshire district, the number of lead poisoning cases in 1896-8 averaged 53 per annum; since 1898 the yearly average has been 3. It is true the number of groundlayers has fallen from 471 to 195, but this is not sufficient to account for the very sudden reduction of lead poisoning at the beginning of 1899. The actual figures and attack rates are as follows:—

Year.	Ground layers (North Staffs.).	
	No. of lead poisoning cases.	Attack per 100 persons employed.
1896 - - -	50	10·6
1897 - - -	55	11·7
1898 - - -	55	11·7
Fans introduced.		
1899 - - -	10	3·0
1900 - - -	7	2·1
1901 - - -	1	0·3
1902 - - -	4	1·7
1903 - - -	3	1·3
1904 - - -	2	0·8
1905 - - -	—	—
1906 - - -	2	1·0
1907 - - -	1	0·5
1908 - - -	—	—

Lithographic Transfer Making.

In January, 1899, a code of special rules was adopted for the works in which lithographic transfers are manufactured for use in pottery; this code embodied provisions exactly similar to those of the 1898 code of rules for earthenware and china, so far as they were applicable. There has been no modification in the rules relating to lithographic transfer making works from 1899 to the present time. The rules are worded as follows:—

SPECIAL RULES FOR THE MANUFACTURE OF TRANSFERS FOR EARTHENWARE AND CHINA.

Duties of Occupiers.

1. No person under 15 years of age shall be employed in making transfers for earthenware or china.

2. All women and young persons employed shall be examined once a month by the certifying surgeon for the district, who shall after May 1st, 1899, have power to order suspension from employment.

No person after such suspension shall be allowed to work without the written sanction of the certifying surgeon.

3. A register, in the form which has been prescribed by the Secretary of State for use in earthenware and china works, shall be kept, and in it the certifying surgeon will enter the dates and results of his visits, the number of persons examined, and particulars of any directions given by him. This register shall contain a list of all persons employed, and shall be produced at any time when required by H.M. Inspector of Factories or by the certifying surgeon.

4. The occupier shall provide and maintain suitable overalls and head coverings for all women and young persons employed in rooms in which colour processes are carried on.

All overalls and head coverings shall be kept by the occupier in proper custody, and shall be washed at least once a week, and suitable arrangements shall be made for carrying out these requirements.

A suitable place shall be provided in which the above workers can deposit clothing put off during working hours.

It shall be a sufficient compliance with the requirements of this rule as to head coverings if they are made of suitable glazed paper, and renewed once a week. The head coverings shall be made so as completely to cover the hair, and to the satisfaction of the Inspector.

5. No person shall be allowed to prepare or partake of any food or drink, or to remain during mealtimes, in any place in which is carried on the making of transfers.

The occupier shall make suitable provision to the reasonable satisfaction of the Inspector in charge of the District for the accommodation during mealtimes of persons employed in such places or processes, with a right of appeal to the Chief Inspector of Factories.

6. Transfer making shall not be carried on without the use of exhaust fans for the effectual removal of dust, or other efficient means for the effectual

removal of dust, to be approved in each particular case by the Secretary of State, and under such conditions as he may from time to time prescribe.

7. The occupier shall provide and maintain sufficient and suitable washing conveniences for all persons employed, as near as is practicable to the places in which such persons are employed.

The washing conveniences shall comprise soap, nail-brushes and towels, and at least one wash-hand basin for every five persons employed as above, with a constant supply of water laid on, with one tap at least for every two basins, and conveniences for emptying the same and running off the waste water on the spot down a waste pipe.

Duties of Persons Employed.

8. All women and young persons employed shall present themselves at the appointed time for examination by the certifying surgeon as provided in Rule 2.

No person after suspension by the certifying surgeon shall work without the written sanction of the certifying surgeon.

9. Every person employed in any room in which colour processes are carried on shall, when at work, wear an overall suit and head covering, which shall not be worn outside the factory or workshop, and which shall not be removed therefrom except for the purpose of being washed. All overalls and head coverings shall be washed or renewed at least once a week.

The overalls and head coverings, when not being worn, shall be deposited in the place provided for the purpose under Rule 4.

Clothing put off during working hours shall be deposited in the place provided for the purpose under Rule 4.

It shall be a sufficient compliance with the requirements of this rule as to head coverings if they are made of suitable glazed paper and renewed once a week. The head coverings shall be made so as completely to cover the hair, and to the satisfaction of the Inspector.

10. No person shall remain during meal-times in any place in which is carried on the making of transfers; or prepare or partake of any food or drink therein at any time.

11. No person shall in any way interfere, without the knowledge and concurrence of the occupier or manager, with the means and appliances provided by the employers for the ventilation of the workshops and for the removal of dust.

12. No person employed shall leave the works or partake of meals without previously and carefully cleaning and washing his or her hands.

Researches Concerning Pottery Glazes.

From 1899 to 1901 the question of the prohibition or limitation of the use of lead received a very great amount of attention, and the agitation against the use of raw lead was very largely directed towards making it compulsory to "frit" the lead with so much silicious matter to render it to a great extent innocuous.

Fritting the Lead.

The process of fritting is in itself a simple one, as it consists merely in mixing together the lead and certain other constituents of the glaze and melting them together to form a glass, which is afterwards ground and added to the remaining ingredients to form the glaze.

Comparative Harmlessness of Fritted Lead.

The 1893 Committee found many leading manufacturers who were already then fritting all their lead, while there were many others who held it to be quite impracticable. Mr. A. P. Laurie, the chemist on that Committee, made a series of experiments to determine the extent to which fritted lead would be insoluble in the stomach and therefore presumably harmless.

Mr. Laurie started from the position established by Dr. Oliver, whose experiments, published in his book on lead poisoning, showed that:—

(1.) Carbonate of lead is soluble both in the gastric juice and in the bile.

(2.) The active dissolving agent in the gastric juice is the free hydrochloric acid it contains, the pepsine exerting no influence.

Mr. Laurie's conclusions were, briefly, that fritted lead is generally much less dangerous than raw lead, but that the frits differ very much among themselves in regard to their solubility in an acid corresponding to the gastric juice. He found most lead frits to be more soluble than lead sulphate, which he took as a standard salt recognised as sufficiently insoluble to be practically non-injurious; on the other hand, he found one frit with 30 per cent. lead and a solubility in dilute hydrochloric acid of little over 1 per cent.

The next official investigation of the subject was undertaken by Dr. (now Sir Edward) Thorpe and Dr. (now Sir Thomas) Oliver, who were appointed in 1898 to inquire into the use of lead compounds in pottery, and published the result of their researches early in 1899.* In this report, after stating their belief that leadless glazes could be used for most pottery, they deal at some length with fritted lead.

Mere fritting of the lead with silicious substances, a practice then well known for upwards of a quarter of a century, is said to reduce the poisonous character of the lead; but this operation is by no means sufficient to produce a harmless compound, and a formula is given which contains 22 per cent. of lead mon-oxide and is almost absolutely insoluble in dilute hydrochloric acid, the lead being held in the form of a double silicate.

Dr. Thorpe and Dr. Oliver next recommend exclusion of females and young persons from dipping house processes, concreting floors, etc., to allow of hosing, and use of india rubber gloves.

They next deal with majolica, jet and rockingham, etc., in which large quantities of lead are used. The investigators considered it doubtful if leadless glazes would be applicable here, but recommend proper fritting of the lead.

Next follow the series of experiments by Dr. Thorpe on lead silicates, *i.e.* frits in use in various British and foreign glazes, and these lead to the conclusions:—

(1.) That simple so-called lead silicates consisting of lead oxide and silica, with very little alumina, lime or alkali, are little better than raw white lead as regards insolubility.

(2.) That double or complex silicates or boro-silicates, in which the lead has been fused not only with silica but also with alumina, lime and alkalies in quantity, can be made with the different ingredients so proportioned that the resulting lead compound is almost wholly insoluble in dilute hydrochloric acid, and may be regarded as practically non-poisonous.

Manufacturers' Statement of 1899.

Under date 26th April, 1899, representatives of the highest standing in practically all branches of pottery manufacture signed a "Statement" in which they comment on the above-named report of Dr. Thorpe and Dr. Oliver.

They emphasise the disasters which would face the trade if lead were prohibited for general china and earthenware. They next turn to the proposed abolition of raw lead, and state with regard to the recommendation of fritting:—

"We are prepared to accept this conclusion, and will in future reduce to a fritt all the lead used in our glazes."

They ask for time to make the necessary experiments, and they ask for assistance from the Government laboratory in determining the solubility of their experimental frits, but they protest altogether against a limitation of the total lead to be used.

Draft Code of Amended Rules Issued.

In 1900 the Home Office issued a draft of amended special rules, of which

Rule 1 proposed to require all lead to be fritted.

Rule 2 sought to establish a standard of insolubility.

The text of the draft code of 1900 is as follows:—

DRAFT AMENDED SPECIAL RULES, AUGUST, 1900.

1. *Lead to be Fritted.*—After January 1st, 1901, no material containing lead which has not been fritted shall be used in any of the following places:—

* Report on Lead Compounds in Pottery, 1899, C. 9207.

Dipping house or dippers' drying room, or in any of the following processes:—
Ware cleaning after the application of glaze by dipping or other process,
Glost placing,
Colour dusting (whether on-glaze or under-glaze),
Colour blowing (whether on-glaze or under-glaze),
Ground laying.
Painting in majolica or other glaze,
Glaze blowing,
Lithographic transfer making,
China scouring,

or in any other place or process in which materials containing lead are used or handled (except for the making of fritts) in the dry state, or in suspension in liquid other than oil or similar medium, or in the form of spray.

Provided that nothing in this rule shall prevent the use of any material which conforms to the standard of insolubility specified in Rule 2.

2. *Lead to be in Insoluble Form.*—After July 1st, 1902, no material containing lead which yields to a dilute solution of hydrochloric acid more than 2 per cent. of its dry weight of a soluble lead compound calculated as lead monoxide when determined in the manner described below, shall be used in any place or process included in Rule 1.

A weighed quantity of dried material is to be continuously shaken for one hour, at the common temperature, with 1,000 times its weight of an aqueous solution of hydrochloric acid containing 0.25 per cent of H Cl. This solution is thereafter to be allowed to stand for one hour and to be passed through a filter. The lead salt contained in an aliquot portion of the clear filtrate is then to be precipitated as lead sulphide, and weighed as lead sulphate.

3. *Samples for Analysis.*—The occupier shall allow any of His Majesty's Inspectors of Factories to take at any time sufficient samples for analysis of any material used.

4. *Age and Sex Limits.*—No woman, young person or child shall be employed in the mixing of unfritted lead compounds in the preparation or manufacture of fritts, glazes, or colours.

5. No person under 15 years of age shall be employed in any place or process included in Rule 1.

Provided that nothing in this Rule shall prevent the employment of young persons over the age of 14 in any place or process (other than china scouring) in which all the materials used conform to the standard of insolubility specified in Rule 2.

6. *Monthly Examination.*—Every person employed in a place or process included in Rule 1 shall be examined once in each calendar month by the Certifying Surgeon for the district.

Provided that if the Certifying Surgeon so allows by signed certificate in the Register, a male over 18 years of age may be employed in a place or process included in Rule 1 without further examination for three calendar months from the date of such certificate.

The Certifying Surgeon may order, by signed certificate in the Register, the suspension of any person from employment in any place or process included in Rule 1; and no person after such suspension shall be allowed to work in any place or process included in Rule 1 without a certificate of fitness from the Certifying Surgeon entered in the Register.

7. *Health Register.*—A register, in the form which has been prescribed by the Secretary of State for use in earthenware and china works, shall be kept, and in it the Certifying Surgeon will enter the dates and results of his visits, the number of persons examined in pursuance of Rule 6, and particulars of any directions given by him. This register shall contain a list of all persons employed in the places and processes included in Rule 1, and shall be produced at any time when required by His Majesty's Inspector of Factories, or by the Certifying Surgeon.

8. *Overalls and Head Coverings.*—The occupier shall provide and maintain suitable overalls and head coverings for all women and young persons employed in the places and processes included in Rule 1.

No person shall be allowed to work in any place or process included in Rule 1, or in the making of fritts, without wearing suitable overalls and head coverings.

All overalls and head coverings, when not in use or being washed or repaired, shall be kept by the occupier in proper custody. They shall be washed or renewed at least once a week. Suitable arrangements shall be made for carrying out these requirements.

A suitable place shall be provided in which the above workers can deposit clothing put off during working hours.

9. *Food.*—No person shall be allowed to keep, or prepare, or partake of any food or drink, or to remain during meal times, in the dipping house or dippers' drying room, or in a place in which is carried on any process included in Rule 1.

The occupier shall make suitable provision to the reasonable satisfaction of the Inspector in charge of the district for the accommodation during meal times of persons employed in such places or processes, with a right of appeal to the Chief Inspector of Factories.

Suitable provision shall be made for the deposit of food brought by the workers.

10. *Dust.*—The processes of—
Towing of earthenware,
China Scouring,
Flat-knocking,
Dry-flint sifting,
Ground laying,
Colour dusting (whether on-glaze or under-glaze),
Colour-blowing (whether on-glaze or under-glaze),
Glaze blowing, or
Transfer making

shall not be carried on without the use of exhaust fans for the effectual removal of dust, or other efficient means for the effectual removal of dust, to be approved in each particular case by the Secretary of State, and under such conditions as he may from time to time prescribe.

In the process of ware cleaning after the dipper, exhaust fans shall be used; or alternatively, if the conditions be such that no dust is produced, arrangements shall be made for any glaze scraped off to fall into water.

In all processes the occupiers shall, as far as practicable, adopt efficient measures for the removal of dust and for the prevention of any injurious effects arising therefrom.

11. *Respirators.*—No person shall be employed in the mixing of unfritted lead compounds, in the preparation or manufacture of fritts glazes or colours containing lead without wearing a suitable and efficient respirator provided and maintained by the employer; unless the mixing is performed in a closed machine or the materials are in such a condition that no dust is produced.

12. *Ventilation.*—All drying stoves as well as all workshops and all parts of factories shall be effectually ventilated to the reasonable satisfaction of the Inspector in charge of the district.

13. *Lavatories.*—The occupier shall provide and continually maintain sufficient and suitable washing conveniences for all persons employed in the places and processes included in Rule 1, as near as practicable to the places in which such persons are employed.

The washing conveniences shall comprise soap, nail-brushes and towels, and at least one wash-hand basin for every five persons employed as above, with a constant supply of water laid on, with one tap at least for every two basins, and conveniences for emptying the same and running off the waste water on the spot down a waste pipe.

There shall be at least two feet of standing room in front of each basin.

14. *Cleansing of Work Places.*—The occupier shall see that the floors of workshops and of such stoves as are entered by the workpeople are sprinkled and swept, daily; that all dust, scraps, ashes and dirt are removed daily, and that the work benches, and stairs leading to workshops, are cleansed weekly.

As regards every potter's shop and stove, and every place and process included in Rule 1, the occupier shall cause the cleansing of floors to be done after other work has ceased for the day, and in the

case of potters' shops, stoves, dipping houses and majolica painting rooms, by an adult male.

15. *Boards.*—The occupier shall cause the boards used in the dipping house, dippers' drying room, or glost placing shop to be cleansed every week, and shall not allow them to be used in any other department, except after being cleansed.

Mangles.—The occupier shall cause every mangle to be washed down every week.

Duties of Persons Employed.

16. *Monthly Examination.*—All persons employed in the places and processes included in Rule 1 shall present themselves at the appointed time for examination by the certifying surgeon as provided in Rule 6.

No person after suspension by the certifying surgeon shall work in any place or process included in Rule 1 without a certificate of fitness from the certifying surgeon entered in the Register.

17. *Overalls.*—Every person employed in a place or process included in Rule 1, or in the making of fritts, shall, when at work, wear an overall suit and head covering, which shall not be worn outside the factory or workshop, and which shall not be removed therefrom except for the purpose of being washed or repaired. All overalls and head coverings shall be washed or renewed at least once a week.

The overalls and head coverings, when not being worn, shall be deposited in the place specified by the occupier for the purpose.

Clothing put off during working hours shall be deposited in the place provided for the purpose under Rule 8.

18. *Food.*—No person shall remain during meal-times in the dipping house, dippers' drying room, or in any place in which is carried on any process included in Rule 1; or introduce, keep, prepare, or partake of any food or drink therein at any time.

19. *Ventilation—Dust.*—No person shall in any way interfere, without the knowledge and concurrence of the occupier, or manager, with the means and appliances provided by the employers for the ventilation of the workshops and stoves and for the removal of dust.

20. *Washing.*—No person employed in a place or process included in Rule 1 shall leave the works or partake of meals without previously and carefully cleaning and washing his or her hands.

21. *Boards.*—The boards used in the dipping house, dippers' drying room, or glost placing shop shall not be used in any other department, except after being cleansed.

Alternative Rule for Processes in which no lead or other poisonous material is used.

22. *Disuse of Lead.*—If the occupier of the factory to which these Rules apply gives, with reference to any place or process (other than china scouring) included in Rule 1, an undertaking that no lead or lead compound or other poisonous material shall be used, the Chief Inspector may approve in writing of the suspension of the operation of Rules 4, 5, 6, 7, 8, 15, 16, 17 and 21, or any of them, in such place or process; and thereupon such Rules shall be suspended as regards the place or process named in the Chief Inspector's approval, and in lieu thereof the following rule shall take effect, viz.: no lead or lead compound or other poisonous material shall be used in any place or process so named.

The above Draft code was sent to manufacturers, and was accompanied by the following letter from the Under-Secretary of State:—

Home Office, Whitehall.
2nd August, 1900.

I am directed by the Secretary of State to forward to you the enclosed draft of amended Special Rules for factories in which the manufacture of china and earthenware and processes incidental to such manufacture are carried on. You will observe that the rules are at present in draft only; and he wished it to be clearly understood that his sending them is not to be regarded as a formal service and proposal of the rules under the powers of the Factory Acts, but is a preliminary measure adopted with a view to simplifying future deliberations.

The rules embody the existing rules as settled by arbitration in 1898, with some alterations, and add new rules for regulating the use of lead in the materials employed.

Some of the points of difference from, and additions to, the existing rules have been explained in previous letters, especially those which turn upon the absence or insolubility of lead in the materials employed.

Taking first the new rules for regulating the use of lead, it will be seen that Rule 1 requires the fritting of lead used in the places and processes specified and is in accordance with the proposition made by the manufacturers in their printed "statement" of 26th April, 1899.

Rule 2 imposes a general standard of insolubility based upon the researches of Dr. Thorpe, which have already been brought to the notice of manufacturers many months ago. In pursuance of the arrangements announced in the Circular Letter of the 14th December, 1899 (last paragraph), a large number of samples of glazes and other materials have been forwarded for examination to the Government Laboratory by manufacturers and others, and many of these have been found to conform to the standard proposed. While its general applicability is thus placed beyond question, the Secretary of State understands that there are particular processes and particular kinds of ware for which at present such a standard is thought by manufacturers to be too stringent, and with regard to which it is suggested, moreover, that some relaxation could be coupled with such conditions as would secure the reasonable safety of the persons employed. He is therefore prepared to defer the full operation of this Rule until July 1st, 1902, in order to afford the fullest opportunity for manufacturers not only to make arrangements for providing themselves with materials which conform to the standard now to be fixed, but also to consider the question in all its bearings, with whatever expert assistance may be necessary. For certain kinds of work, however, there should be no difficulty in conforming at once, and the Secretary of State will be glad to be informed when this is done. In such cases it will be possible for the manufacturer to take advantage of the proviso in Rule 5.

It is possible there may be certain exceptional cases and processes in which it will not be practicable to apply the provisions of Rules 1 and 2, and that some power to suspend the operation of those rules in such cases will be necessary. The Secretary of State will be prepared to consider any suggestion that may be made to him by the manufacturers on the point.

In the Circular Letter of December 14th last, it was intimated that the Secretary of State would be prepared to relax certain of the requirements of the Special Rules in respect of places and processes in which no lead is used. Rule 22 gives effect to this, and it is hoped that manufacturers generally will discard the use of even the less harmful forms of lead in those branches in which leadless materials fulfil the necessary conditions of manufacture.

Rule 3 is a necessary corollary to Rules 1, 2 and 22. The samples for analysis will, of course, be taken in such a manner as to ensure that they represent fairly the materials used.

Coming now to the existing rules, the Secretary of State may briefly notice the principal alterations that have been introduced. Rule 4 is new; but the Secretary of State understands that the requirement is already generally observed. Apart from the addition of explanatory words, Rule 5 differs in its effect from the present Rule 1 mainly in the insertion of *colour blowing* and of general words to cover any new process of a dangerous kind which may come into use. The Secretary of State thinks it will be possible in processes in which the standard of insolubility laid down by Rule 2 has been attained, to allow some relaxation in regard to the employment of young persons, and a proviso is accordingly added to the rule that in such processes the employment of young persons between the ages of 14 and 15 will be permitted.

It will be observed that while extending to adult males, as recommended by the manufacturers, the requirement of periodic medical examination hitherto limited to women and young persons, Rule 6 permits the interval between the examinations in the case of adult males to be extended to three months in any given instance at the discretion of the certifying surgeon. This distinction is made at the suggestion

of certifying surgeons who have had most experience in the North Staffordshire Potteries, and who are of opinion that the men engaged in the lead processes are for the most part old and seasoned hands, for whom a monthly examination would in many instances be unnecessary.

The further alterations in the terms of the Rule are designed to make the meaning of the present Rule 2 more clear. The intention was that the certifying surgeon should enter his certificate in the register, but this has not in all cases been understood or practised. It will not be necessary to alter the form of register on this account, but the Secretary of State will be glad to have any suggestions for improvement of the form now in use.

In Rule 10, which substantially reproduces the present Rule 6, three additional dusty processes, viz., colour blowing, flat-knocking, and dry-flint sifting, are added to the list of those in which mechanical ventilation is required. In ware cleaning the alternative arrangement for the débris to fall into water is limited to those cases in which no dust is produced.

Rule 11 is concerned with the *preparation of fritts, etc.*, containing lead and requires respirators to be provided if dust is given off. The present Rules make no reference to this dangerous branch of work.

Upon Rule 14, which replaces existing Rule 16, the Secretary of State desires to make the following observations. Hitherto Special Rules for this manufacture have thrown upon the operatives the duty of cleansing the floors, etc., of the places in which they work. This appears to be in accordance with the traditional practice in the Potteries, and the rule to that effect was introduced in 1893 at the instance of the workpeople. It is, however, an anomalous arrangement. The statutory responsibility for keeping the factory in a cleanly state is placed by the Acts on the occupier, and the Secretary of State may point out that the usual practice not only in other industries, but also in some china and earthenware works outside Staffordshire, is for the occupier to provide for the cleanliness of his own factory. The present wording is doubly misleading in making it appear (1) that the occupier is freed from responsibility, and (2) that he is *compelled to* make the workmen pay for keeping clean certain parts of the factory. Moreover, recent experience has shown the necessity of extending the provisions for cleansing to places which are not included in the present rules and to which the existing arrangement cannot be applied. It appears to the Secretary of State that the time has come when the question should be placed on a footing more in harmony with the provisions of the Factory Acts, while leaving the occupier, as between himself and his workpeople, to make such arrangements as may be agreed upon. In re-drafting this requirement the phrase "after working hours" has been altered to "after all other work had ceased for the day" in order to make it clear that the cleansing, if work had ceased, need not be deferred until after the appointed statutory "period of employment." The Secretary of State may add that it has been suggested that in exceptional cases, such as that of the china dippers' drying room, the sweeping ought to be done (with due precautions) in the morning before work is commenced. Any such exception would require express modification of the Rule, and the Secretary of State will be glad to consider any observations upon this point.

The reference to dipping-house boards in Rules 15 and 21 has been modified in order to distinguish more clearly the duties of employers and employed. A requirement has also been added that the "mangle" shall be washed down weekly.

The other modifications are chiefly upon points of detail which do not seem to call for lengthened explanation.

It is scarcely necessary to say in conclusion that the Rules are not intended to exhaust the precautions which are desirable in this industry. There are many points in which the health and safety of workpeople depend upon precautions to be taken by the manufacturers in matters of construction and administration, which nevertheless do not lend themselves readily to precise definition as formal requirements. These the Secretary of State leaves with confidence to the discretion of the employers. As a single instance of the kind may be mentioned the danger of allowing workmen to enter kilns after firing, until a sufficient time has elapsed to allow of cooling. The Secretary of State is glad to learn from the reports of the inspectors that improvements in detail, outside the Rules, have been made by individual manufacturers. These, and other suggestions that may arise for the amendment of the conditions under which the dangerous branches of the industry are carried on, will be communicated to manufacturers from time to time.

When the Rules have been finally settled for the china and earthenware industry it will be necessary to consider the bearing of some of them upon certain incidental or allied processes when carried on in separate factories. In the case of transfer making, action upon these lines has already been taken.

Lastly, in the Circular Letter of the 14th December last, it was pointed out that the increased duties which will in future devolve upon the certifying surgeons under the amended Special Rules would necessitate a revision of the scale of fees prescribed in the Second Schedule to the Factory Act, 1895. The Secretary of State proposes to substitute the following scale:—

> "For each visit, including such examinations, entries in registers, issue of certificates, and other duties as may be required by Special Rules. (*a*) When the examination is at a factory or workshop within a mile from the certifying surgeon's central point, 2s. 6d. for each visit and 6d. for each person after the first five presented at that visit. (*b*) When the examination is at a factory or workshop more than a mile from the central point, the above fees with an additional 1s. for each mile or portion of a mile beyond the first mile."

I am,

Your obedient servant,

KENELM E. DIGBY.

Negotiations of 1900.

After the above draft code and covering letter had been sent to the manufacturers, lengthy negotiations ensued, and conferences were held with a view to securing agreement on the principal points of issue.

Both Mr. Burton and Mr. Moore, who represented the manufacturers throughout the negotiations, offered to advise the manufacturers to accept a standard of solubility not exceeding 5 per cent. for white and lightly tinted glazes; but the Home Office, acting on the advice of Dr. Thorpe, rejected this compromise. In January, 1901, accordingly, a new code was formally served on the manufacturers; this embodied certain minor amendments on the lines agreed upon by Mr. Burton and Mr. Moore at a conference held at the Home Office on October 26th and 27th, 1900; but it retained, as originally proposed in Rule 2, two per cent. as the limit of soluble lead to be allowed in glazes, subject to an implied reservation that this should only apply strictly to white and lightly tinted glazes for ordinary earthenware and china, and that exemptions should be allowed for coloured glazes.

The code served in January, 1901, read as follows:—

DRAFT AMENDED SPECIAL RULES, JANUARY, 1901.

(Containing the alterations agreed upon at the Conference with Mr. Burton and Mr. Moore on October 26th and 27th, 1900.)

Earthenware and China Works.

1. *Lead to be Fritted.*—After January 1st, 1901, no material containing lead which has not been fritted shall be used in any of the following places:
   - Dipping-house or dippers' drying room,

   or in any of the following processes:—
   - Ware cleaning after the application of glaze by dipping or other process,
   - Glost placing,
   - Colour dusting (whether on-glaze or under-glaze),
   - Colour blowing (whether on-glaze or under-glaze),
   - Groundlaying,
   - Painting in majolica or other glaze,
   - Glaze blowing,
   - Lithographic transfer making,

   or in any other place or process in which materials containing lead are used or handled in the dry state (except for the making of fritts), or in the form of

spray, or in suspension in liquid other than oil or similar medium.

Provided that nothing in this Rule shall prevent the use of any material which conforms to the standard of insolubility specified in Rule 2.

2. *Lead to be in Insoluble Form.*—After July 1st, 1902, no glaze shall be used which yields to a dilute solution of hydrochloric acid more than 2 per cent. of its dry weight of a soluble lead compound calculated as lead monoxide when determined in the manner described below.

A weighed quantity of dried material is to be continuously shaken for one hour, at the common temperature, with 1,000 times its weight of an aqueous solution of hydrochloric acid containing 0·25 per cent. of H Cl. This solution is thereafter to be allowed to stand for one hour and to be passed through a filter. The lead salt contained in an aliquot portion of the clear filtrate is then to be precipitated as lead sulphide and weighed as lead sulphate.

3. *Samples for Analysis.*—The occupier shall allow any of Her Majesty's Inspectors of Factories to take at any time sufficient samples for analysis of any material in use or mixed for use.

Provided that the occupier may at the time when the sample is taken, and on providing the necessary appliances, require the Inspector to take, seal, and deliver to him a duplicate sample.

4. *Age and Sex Limits.*—No woman, young person or child shall be employed in the mixing of unfritted lead compounds in the preparation or manufacture of fritts, glazes, or colours.

5. No person under 15 years of age shall be employed in any place or process included in Rule 1, or in the process of china scouring.

Provided that nothing in this Rule shall prevent the employment of young persons over the age of 14 in any place or process (other than china scouring) in which all the materials used conform to the standard of insolubility specified in Rule 2.

6. *Monthly Examination.*—Every person employed in a place or process included in Rule 1, or in the process of china scouring, shall be examined once in each calendar month by the Certifying Surgeon for the district.

The Certifying Surgeon may order, by signed certificate in the Register, the suspension of any person from employment in any place or process included in Rule 1, or in the process of china scouring; and no person after such suspension shall be allowed to work in any place or process included in Rule 1, or in the process of china scouring, without a certificate of fitness from the Certifying Surgeon entered in the Register.

7. *Health Register.*—A register, in the form which has been prescribed by the Secretary of State for use in earthenware and china works, shall be kept, and in it the Certifying Surgeon will enter the dates and results of his visits, the number of persons examined in pursuance of Rule 6, and particulars of any directions given by him. This register shall contain a list of all persons employed in the places and processes included in Rule 1, or in the process of china scouring, and shall be produced at any time when required by Her Majesty's Inspector of Factories or by the Certifying Surgeon.

8. *Overalls and Head Coverings.*—The occupier shall provide and maintain suitable overalls and head coverings for all women and young persons employed in the places and processes included in Rule 1, or in the process of china scouring.

No person shall be allowed to work in any place or process included in Rule 1, or in the process of china scouring, or in the mixing of unfritted lead compounds, without wearing suitable overalls and head coverings.

All overalls and head coverings, and respirators, when not in use or being washed or repaired, shall be kept by the occupier in proper custody. They shall be washed or renewed at least once a week. Suitable arrangements shall be made for carrying out these requirements.

A suitable place, other than that provided for the keeping of overalls, head covering, and respirators, shall be provided in which the above workers can deposit clothing put off during working hours. Provided that nothing in this Rule shall render it obligatory on any person engaged in drawing glost ovens to wear overalls and head coverings.

9. *Food.*—No person shall be allowed to keep, or prepare, or partake of any food or drink, or tobacco, or to remain during meal times, in the dipping-house or dippers' drying room, or in a place in which is carried on any process included in Rule 1 or china scouring.

The occupier shall make suitable provision to the reasonable satisfaction of the Inspector in charge of the district for the accommodation during meal times of persons employed in such places or processes, with a right of appeal to the Chief Inspector of Factories. Such accommodation shall not be provided in any room or rooms which are included in Rule 1, or in which china scouring is carried on, or in a lavatory.

Suitable provision shall be made for the deposit of food brought by the workers.

10. *Dust.*—The processes of—

Towing of earthenware,
China scouring,
Flat-knocking,
Dry-flint sifting,
Groundlaying,
Colour dusting (whether on-glaze or under-glaze),
Colour blowing (whether on-glaze or under-glaze),
Glaze blowing, or
Transfer making,

shall not be carried on without the use of exhaust fans for the effectual removal of dust, or other efficient means for the effectual removal of dust, to be approved in each particular case by the Secretary of State, and under such conditions as he may from time to time prescribe.

In the process of ware cleaning after the dipper, exhaust fans shall be used; or alternatively, if the conditions be such that no dust is produced, arrangements shall be made for any glaze scraped off to fall into water.

In all processes the occupier shall, as far as practicable, adopt efficient measures for the removal of dust and for the prevention of any injurious effects arising therefrom.

11. *Respirators.*—No person shall be employed in the mixing of unfritted lead compounds, in the preparation or manufacture of fritts glazes or colours containing lead without wearing a suitable and efficient respirator provided and maintained by the employer; unless the mixing is performed in a closed machine or the materials are in such a condition that no dust is produced.

12. *Ventilation.*—All drying stoves as well as all workshops and all parts of factories shall be effectually ventilated to the reasonable satisfaction of the Inspector in charge of the district.

13. *Lavatories.*—The occupier shall provide and continually maintain sufficient and suitable washing conveniences for all persons employed in the places and processes included in Rule 1, or in the process of china scouring, as near as practicable to the places in which such persons are employed.

The washing conveniences shall comprise soap, nail-brushes and towels, and at least one wash-hand basin for every five persons employed as above, with a constant supply of water laid on, with one tap at least for every two basins, and conveniences for emptying the same and running off the waste water on the spot down a waste pipe.

There shall be at least two feet of standing room in front of each basin.

14. *Cleansing of Work Places.*—The occupier shall see that the floors of workshops and of such stoves as are entered by the workpeople are sprinkled and swept daily; that all dust, scraps, ashes, and dirt are removed daily, and that the mangles, work benches, and stairs leading to workshops, are cleansed weekly.

As regards every potter's shop and stove, and every place and process included in Rule 1, and the process of china scouring, the occupier shall cause the cleansing of floors to be done after other work has ceased for the day, and in the case of potters' shops, stoves, dipping houses, and majolica painting rooms, by an adult male.

15. *Boards.*—The occupier shall cause the boards used in the dipping house, dippers' drying room, or

glost placing shop to be cleansed every week, and shall not allow them to be used in any other department, except after being cleansed.

DUTIES OF PERSONS EMPLOYED.

16. *Monthly Examination.*—All persons employed in the places and processes included in Rule 1, or in the process of china scouring, shall present themselves at the appointed time for examination by the Certifying Surgeon as provided in Rule 6.

No person after suspension by the Certifying Surgeon shall work in any place or process included in Rule 1, or in the process of china scouring, without a certificate of fitness from the Certifying Surgeon entered in the Register.

17. *Overalls.*—Every person employed in a place or process included in Rule 1, or in the process of china scouring, or in the mixing of unfritted lead compounds, shall, when at work, wear an overall suit and head covering, and also a respirator when so required by Rule 11, which shall not be worn outside the factory or workshop, and which shall not be removed therefrom except for the purpose of being washed or repaired. All overalls and head coverings shall be washed or renewed at least once a week.

The hair must be so arranged as to be fully protected from dust by the head covering.

The overalls, head coverings, and respirators, when not being worn, shall be deposited in the place specified by the occupier for the purpose.

Clothing put off during working hours shall be deposited in the place provided for the purpose under Rule 8.

18. *Food.*—No person shall remain during mealtimes in the dipping house, dippers' drying room, or in any place in which is carried on any process included in Rule 1, or in the process of china scouring; or introduce, keep, prepare, or partake of any food or drink or tobacco therein at any time.

19. *Ventilation—Dust.*—No person shall in any way interfere, without the knowledge and concurrence of the occupier, or manager, with the means and appliances provided by the employers for the ventilation of the workshops and stoves, and for the removal of dust. No person employed shall remove or damage the washing conveniences provided under Rule 13.

20. *Washing.*—No person employed in a place or process included in Rule 1, or in the process of china scouring, shall leave the works or partake of meals without previously and carefully cleaning and washing his or her hands.

21. *Boards.*—The boards used in the dipping house, dippers' drying room, or glost placing shop shall not be used in any other department, except after being cleansed.

ALTERNATIVE RULE FOR PROCESSES IN WHICH NO LEAD OR OTHER POISONOUS MATERIAL IS USED.

22. *Disuse of Lead.*—If the occupier of the factory to which these Rules apply gives, with reference to any place or process included in Rule 1, an undertaking that no lead or lead compound or other poisonous material shall be used, the Chief Inspector may approve in writing of the suspension of the operation of Rules 4, 5, 6, 7, 8, 15, 16, 17, and 21, or any of them, in such place or process; and thereupon such Rules shall be suspended as regards the place or process named in the Chief Inspector's approval, and in lieu thereof the following rule shall take effect, viz.: no lead or lead compound or other poisonous material shall be used in any place or process so named.

Accompanying this Draft Code, as issued, was the following:—

NOTE AS TO POINTS STILL REMAINING FOR DISCUSSION.

1. The Secretary of State accepts the principle of the manufacturers' proposal that certain exceptional processes should be exempted from the provisions in Rule 1. It was agreed, however, at the Conference that the best means of giving effect to the proposal was that a general power should be given in the Rules to the Secretary of State to grant exemptions, and that the terms of the exemption which he would propose to issue should be communicated to the manufacturers before the Rules become established.

2. With regard to Rule 2, it was agreed at the Conference that Dr. Thorpe should make experiments with the view of determining the effect of fineness of grinding on the solubility of the fritted compound.

3. As regards the provisions in Rule 10 with regard to flat-knocking, dry-flint sifting and ware cleaning, it was agreed that Mr. Osborn should make enquiry into the matters with Mr. Burton and Mr. Moore. This has now been done. As regards the first two processes, the following Rule has been agreed upon between them, which the Secretary of State is prepared to accept, viz.:—

> "Flat-knocking and fired-flint-sifting shall be carried on only in enclosed receptacles which shall be connected with an efficient fan or other efficient draught unless so contrived as to prevent effectually the escape of injurious dust."

As regards "ware cleaning," the purpose of the words to which the manufacturers object ("if the conditions be such that no dust is produced") was to provide that in any exceptional cases in which dust is diffused in the air during the process of ware-cleaning the provision of a fan or other effectual means of removal should be necessary. The Secretary of State agrees, however, that such cases can be dealt with under the Rule as it stands and the general powers of the Act, and does not propose to press for the insertion of the words.

4. The Secretary of State is informed that the last paragraph of Rule 13 has been misunderstood. It was intended that the two feet should be measured *along* the stand on which the basins are placed, and not *back* from it. It appears, however, to be necessary for the completeness of the Rule that both measurements should be prescribed, and the Secretary of State will be glad to have the observations of the manufacturers on the question of the space to be allotted to each basin.

5. It was agreed at the Conference that an exception to Rule 14 should be made as regards certain processes (to be specified in the Rule) to allow the cleaning to be done "at a time when no other work is being carried on in such room" instead of "after the work has ceased for the day." The Secretary of State understands that a list of such processes will be proposed by the manufacturers.

It was agreed that words should be added providing that in no case should work be resumed within half an hour after sweeping.

6. Rule 20*a*, proposed by the manufacturers, would have the effect of dividing the responsibility for the cleanliness of the factory, and the Secretary of State was on this ground unable to accept it. The question whether a rule could be passed which would attain the object that the manufacturers have in view, without being open to the objection of dividing the responsibility, was left for further consideration.

Objections and Reference to Arbitration.

Formal notices of objection to this new code were at once sent to the Home Office by nearly all the pottery manufacturers of the country; and the whole question of a new set of rules was referred to arbitration in accordance with the provisions of the Factory and Workshop Acts of 1891 and 1895. The Home Office nominated Mr. Chester Jones as their Arbitrator, and a few of the objecting manufacturers agreed to abide by his sole decision; the other firms, however, represented by the Joint Committee of Manufacturers' Associations, nominated Mr. Llewellyn to act as Arbitrator on their behalf, and Lord James of Hereford was selected as Umpire.

While the Home Office, by their Counsel, put forward the Code of January, 1901, above quoted, the manufacturers asked for the following modifications:—

Manufacturers' Proposed Amendments to Draft Code of 1900.

Rule 1.—After July 1st, 1901, no material containing lead which has not been fritted *with some siliceous substance* shall be used in any of the following places:

- Dipping house or dippers' drying room, or in any of the following processes:—
- Ware cleaning after the application of glaze by dipping or other process,
- Glost placing,
- Colour dusting (whether on-glaze or under-glaze),
- Colour blowing (whether on-glaze or under-glaze),
- Ground laying,
- Painting in majolica or other glaze,
- Glaze blowing,
- Lithographic transfer making,

or in any other place or process in which materials containing lead are used or handled in the dry state (except for the making of frits), or in the form of spray, or in suspension in liquid other than oil or similar medium.

Provided that nothing in this rule shall prevent the use of any *unfritted* material which conforms to *an agreed* standard of insolubility *for such material.*

Provided also that the Secretary of State shall issue a general certificate (to remain in operation concurrently with these Rules) exempting from the operation of this rule certain subsidiary processes which have been already communicated to the Home Office by Manufacturers.

Rule 2.—*Objected to in toto.*

Rule 3.—The occupier shall allow any of His Majesty's Inspectors of Factories to take at any time sufficient samples for analysis of any material in use or mixed for use provided that the occupier may at the time the sample is taken, and on providing the necessary appliances, require the Inspector to take, seal, and deliver to him a duplicate sample. *But no analytical result shall be disclosed or published in any way except such as shall be necessary to establish a breach of these Rules.*

Rule 4.—*Approved.*

Rule 5.—No person under 15 years of age shall be employed in any place or process included in Rule 1, or in the process of china scouring.

Provided that nothing in this rule shall prevent the employment of young persons over the age of 14 in any place or process (other than china scouring), in which all the materials used conform to *these rules.*

Rule 6.—Every person employed in a place or process included in Rule 1, or in the process of china scouring, shall be examined once in each calendar month by the certifying surgeon for the district.

The certifying surgeon may order, by signed certificate in the register, the suspension of any person *other than an adult male* from employment in any place or process included in Rule 1, or in the process of china scouring; and no *such* person after such suspension shall be allowed to work in any place or process included in Rule 1, or in the process of china scouring, without a certificate of fitness from the certifying surgeon entered in the register.

Rule 7.—*Approved.*

Rule 8.—The occupier shall provide and maintain suitable overalls and head coverings for all women and young persons employed in the places and processes included in Rule 1, or in the process of china scouring.

No person shall be allowed to work in any place or process included in Rule 1, in the process of china scouring or in the mixing of unfritted lead compounds without wearing suitable overalls and head coverings.

All overalls, head coverings, and respirators, when not in use or being washed or repaired, shall be kept by the occupier in proper custody. They shall be washed or renewed at least once a week. Suitable arrangements shall be made for carrying out these requirements.

A suitable place, other than that provided for the keeping of overalls, head coverings and respirators, shall be provided in which the above workers can deposit clothing put off during working hours. Provided that nothing in this rule shall render it obligatory on any person engaged in drawing glost ovens to wear overalls and head coverings.

Each respirator shall bear the distinguishing mark of the worker to whom it is supplied.

Rule 9.—No person shall be allowed to keep, or prepare, or partake of any food or drink, or tobacco, or to remain during meal-time in the dipping-house or dippers' drying room, or in a place in which is carried on any process included in Rule 1 or china scouring.

The occupier shall make suitable provision to the reasonable satisfaction of the inspector in charge of the district for the accommodation during meal-times of persons employed in such places or processes, with a right of appeal to the Chief Inspector of Factories. Such accommodation shall not be provided in any room or rooms which are included in Rule 1, or in which china scouring is carried on.

Suitable provision shall be made for the deposit of food brought by the workers.

N.B.—*The reason why manufacturers object to the insertion of the words, "or in a lavatory," is that in some of the most modern and best appointed Factories there are a few wash-hand basins at one end of the dining-room for the convenience of the workpeople.*

Rule 10.—The processes of—
The towing of earthenware,
China scouring,
Ground laying,
Colour dusting (whether on-glaze or under-glaze),
Colour blowing (whether on-glaze or under-glaze),
Glaze blowing, or
Transfer making,

shall not be carried on without the use of exhaust fans for the effectual removal of dust, or other efficient means for the effectual removal of dust, to be approved in each particular case by the Secretary of State, and under such conditions as he may from time to time prescribe.

In the process of ware cleaning after the dipper exhaust fans shall be used, or, alternatively, arrangements shall be made for any glaze scraped off to fall into water.

Flat knocking and fired-flint-sifting shall be carried on only in enclosed receptacles which shall be connected with an efficient fan or other efficient draught unless so contrived as to prevent effectually the escape of injurious dust.

In all processes the occupier shall, as far as practicable, adopt efficient measures for the removal of dust and for the prevention of any injurious effects arising therefrom.

Rule 11.—*Approved.*

Rule 12.—*Approved.*

Rule 13.—The occupier shall provide and continually maintain sufficient and suitable washing conveniences for all persons employed in the places and processes included in Rule 1, or in the process of china scouring, as near as practicable to the places in which such persons are employed.

The washing conveniences shall comprise soap, nail-brushes and towels, and at least one wash-hand basin for every five persons employed as above with a constant supply of water laid on, with one tap at least for every two basins, and conveniences for emptying the same and running off the waste water on the spot down a waste-pipe.

Rule 14.—The occupier shall see that the floors of workshops and of such stoves as are entered by the workpeople are sprinkled and swept daily, that all dust, scraps, ashes and dirt are removed daily, and that the mangles, work benches and stairs leading to workshops are cleansed weekly.

As regards every potter's shop and stove, and every place and process included in Rule 1, or in the process of china scouring, the occupier shall cause the cleansing of floors to be done *at a time when no other work is being carried on in such room,* and in the case of potters' shops, stoves, dipping-houses and majolica painting rooms by an adult male, *employed and paid by the workers and approved by the employers.*

Provided that in no case shall work be resumed in such room within half-an-hour after such cleaning.

Rule 15.—*Approved.*

Rule 16.—All persons employed in the places and processes included in Rule 1, or in the process of china scouring, shall present themselves at the appointed time for examination by the Certifying Surgeon as provided in Rule 6.

No person *other than an adult male* after suspension by the Certifying Surgeon shall work in any place or process included in Rule 1 or in the process of china scouring without a certificate of fitness from the Certifying Surgeon entered in the register.

Rule 17.—*Approved.*

Rule 18.—*Approved.*

Rule 19.—*Approved.*

Rule 20.—*Approved.*

Rule 20a.—*The persons employed shall be responsible conjointly with the occupier for the daily sprinkling and sweeping of the floors of the workshops and of such stoves as are entered by the workpeople; and for the*

daily removal of dust, scraps, ashes and dirt; and for the weekly cleansing of work benches and of stairs leading to workshops.

Each person shall be responsible for the cleansing of that portion of the room in which he or she is employed.

Rule 21.—*Approved.*

Rule 22.—If the occupier of the factory to which these Rules apply gives, with reference to any place or process included in Rule 1, an undertaking that no lead or lead compound or other poisonous material shall be used, the Chief Inspector may approve in writing of the suspension of the operation of Rules 5, 6, 7, 8, 15, 16, 17 and 21, or any of them, in such place or process, and thereupon such Rules shall be suspended as regards the place or process named in the Chief Inspector's approval, and in lieu thereof the following Rule shall take effect, viz.: no lead or lead compound or other poisonous material shall be used in any place or process so named.

For the purpose of this Rule a leadless glaze shall be defined as one that contains no more than 1 per cent. of lead oxide.

Operatives' Proposed Amendments to Draft Code of 1900.

The operatives, who were also represented by Counsel, largely supported the Home Office case; they indicated their position at the opening of the Arbitration in the following terms:—

Rule 1.—*Approved.*—The other modifications suggested by the manufacturers will be opposed by the operatives.

Rule 2.—The interests of the operatives will be watched by counsel.

Rule 3.—*Approved.*—No objection will be made to the addition proposed by the manufacturers.

Rule 4.—*Approved.*

Rule 5.—*Approved*, with the additions that china scouring shall be held for the purposes of these rules to include the processes of brushing of hollow ware and fine brushing, and that young persons and women shall be excluded from employment as dippers, dippers' assistants, ware-cleaners after dippers, and glost-placers in factories where lead glaze is used.

The modification suggested by the employers is objected to.

Rule 6.—This rule cannot be approved by the operatives so long as the Workmen's Compensation Act is not amended so as to include lead poisoning. The modification suggested by the manufacturers does not meet this objection on the part of the operatives.

The rule (provided the Compensation Act is amended) should apply also to the persons to whom Rule 11 applies.

Rule 7.—*Approved*, with the addition that the certifying surgeon, referred to in Rule 6 and 7, shall be appointed by the Home Office, and shall be prohibited from taking private practice, and that this rule shall apply to the persons to whom Rule 11 applies.

Rule 8.—*Approved*, provided the following words are added to paragraph 3: "such as shall exclude the washing of overalls by the individual workers in their own homes."

The addition made by the manufacturers is approved.

Rule 9.—Add "or other unsuitable place." The omission suggested by the manufacturers is objected to by the operatives.

N.B.—The addition of the words "other unsuitable place" is desired by the operatives, as the rule as it stands might be interpreted to imply that any place other than those mentioned is suitable for meals.

Rule 10.—Add at the end of the first paragraph: "Such fans shall be of proper construction constantly maintained and used." Paragraph 2 shall read with the addition that—"The vessels provided for the purpose shall be of a size proportionate to the articles cleaned, so that all glaze shall fall into the water. The vessels shall be emptied, washed and refilled daily. Damp sponges shall be used for ware cleaning instead of knives."

The addition of the manufacturers is accepted by the operatives.

Rule 11.—*Approved.*

Rule 12.—*Approved.*

Rule 13.—Insert "sufficient supply of" before towels, and "fixed" before basins.

Rule 14.—*Approved*, provided that the word "washed" is substituted for "cleansed." The additions made by the employers are objected to.

All clay potters' shops, china scouring rooms and earthenware dipping houses shall be swept after the workers have ceased for the day.

Rule 15.—*Approved*, provided that the word "washed" is substituted for "cleansed."

N.B.—This alteration is not intended to apply to the nailed boards sometimes used to dry plates on.

Rule 16.—Opposed under existing conditions as above—*See* Rule 6. If amended the rule should apply to those persons to whom Rule 11 applies.

Rule 17.—*Approved.*

Rule 18.—*Approved.*

Rule 19.—*Approved.*

Rule 20.—*Approved.*

Rule 20a.—Proposed by the manufacturers, is objected to by the operatives.

Rule 21.—*Approved*, provided that the word "washed" is substituted for "cleansed."

Rule 22.—*Approved.* The addition proposed by the manufacturers is opposed by the operatives, but no objection would be made to a separate rule to the effect that ware dipped in leadless glaze shall be defined as leadless glaze ware, provided that on analysis the glaze contains no more than 1 per cent. of lead oxide.

Additional Rules suggested by the Operatives.

Rule 23.—All processes mentioned in Rules 1 and 10 shall be carried on in separate departments, except flat-knocking and fired-flint-sifting if carried on in enclosed receptacles so contrived as to prevent effectually the escape of injurious dust.

Rule 24.—All buildings or parts of buildings constructed after July 1st, 1901, in which the processes referred to in Rules 1 or 10 are carried on shall have tiled or concrete floors which shall be maintained in good repair.

Umpire's Award of 1901.

After the hearing had lasted four days, Lord James of Hereford adjourned the proceedings for 18 months, in so far as related to the proposed Rules 1 and 2. He issued his award on Rules 3 to 22, however, in December, 1901; Mr. Chester Jones immediately afterwards made an Award in identical terms to apply to those firms who had accepted him as sole Arbitrator; and the following code accordingly came into force early in 1902:—

AMENDED SPECIAL RULES FOR THE MANUFACTURE OF EARTHENWARE AND CHINA.

As established, after Arbitration, by the Award of the Umpire, Lord James of Hereford, dated 30th of December, 1901.

Duties of Occupiers.

1 and 2. Postponed.

3. *Samples for Analysis.*—The occupier shall allow any of His Majesty's Inspectors of Factories to take at any time sufficient samples for analysis of any material in use or mixed for use.

Provided that the occupier may at the time when the sample is taken, and on providing the necessary appliances, require the Inspector to take, seal, and deliver to him a duplicate sample.

But no analytical result shall be disclosed or published in any way except such as shall be necessary to establish a breach of these rules.

4. *Age and Sex Limits.*—No woman, young person, or child shall be employed in the mixing of unfritted lead compounds in the preparation or manufacture of fritts, glazes, or colours.

5. No person under 15 years of age shall be employed in any process included in Schedule A, or in emptying china biscuit ware.

Thimble-picking, or threading-up, or looking-over biscuit ware shall not be carried on except in a place

sufficiently separated from any process included in Schedule A.

6. *Monthly Examination.*—All women and young persons employed in any process included in Schedule A shall be examined once in each calendar month by the certifying surgeon for the district.

The certifying surgeon may order by signed certificate in the register the suspension of any such women or young persons from employment in any process included in Schedule A, and no person after such suspension shall be allowed to work in any process included in Schedule A without a certificate of fitness from the certifying surgeon entered in the register.

7. *Health Register.*—A register, in the form which has been prescribed by the Secretary of State for use in earthenware and china works, shall be kept, and in it the certifying surgeon shall enter the dates and results of his visits, the number of persons examined in pursuance of Rule 6 as amended, and particulars of any directions given by him. This register shall contain a list of all persons employed in the processes included in Schedule A, or in emptying china biscuit ware, and shall be produced at any time when required by H.M. Inspector of Factories, or by the certifying surgeon.

8. *Overalls and Head-coverings.*—The occupier shall provide and maintain suitable overalls and head-coverings for all women and young persons employed in the processes included in the Schedule A, or in emptying china biscuit ware.

No person shall be allowed to work in any process included in the Schedule, or in emptying china biscuit ware, without wearing suitable overalls and head-coverings, provided that nothing in this rule shall render it obligatory on any person engaged in drawing glost ovens to wear overalls and head-coverings.

All overalls, head-coverings, and respirators, when not in use or being washed or repaired, shall be kept by the occupier in proper custody. They shall be washed or renewed at least once a week, and suitable arrangements shall be made by the occupier for carrying out these requirements.

A suitable place, other than that provided for the keeping of overalls, head-coverings, and respirators, in which all the above workers can deposit clothing put off during working hours, shall be provided by the occupier.

Each respirator shall bear the distinguishing mark of the worker to whom it is supplied.

9. *Food.*—No person shall be allowed to keep, or prepare, or partake of any food, or drink, or tobacco, or to remain during meal-times in a place in which is carried on any process included in Schedule A.

The occupier shall make suitable provision to the reasonable satisfaction of the inspector in charge of the district for the accommodation during meal-times of persons employed in such places or processes, with a right of appeal to the chief inspector of factories. Such accommodation shall not be provided in any room or rooms in which any process included in Schedule A is carried on, and no washing conveniences mentioned hereafter in Rule 13 shall be maintained in any room or rooms provided for such accommodation.

Suitable provision shall be made for the deposit of food brought by the workers.

10. *Dust.*—The processes of :—

The towing of earthenware,
China scouring,
Ground laying,
Ware cleaning after the dipper,
Colour dusting, whether on-glaze or under-glaze,
Colour blowing, whether on-glaze or under-glaze,
Glaze blowing, or
Transfer making,

shall not be carried on without the use of exhaust fans, or other efficient means for the effectual removal of dust, to be approved in each particular case by the Secretary of State, and under such conditions as he may from time to time prescribe.

In the process of ware cleaning after the dipper, sufficient arrangements shall be made for any glaze scraped off which is not removed by the fan, or the other efficient means, to fall into water.

In the process of ware cleaning of earthenware after the dipper, damp sponges or other damp material shall be provided in addition to the knife or other instrument, and shall be used wherever practicable.

Flat-knocking and fired-flint-sifting shall be carried on only in enclosed receptacles, which shall be connected with an efficient fan or other efficient draught unless so contrived as to prevent effectually the escape of injurious dust.

In all processes the occupier shall, as far as practicable, adopt efficient measures for the removal of dust and for the prevention of any injurious effects arising therefrom.

11. *Respirators.*—No person shall be employed in the mixing of unfritted lead compounds, in the preparation or manufacture of fritts, glazes or colours containing lead without wearing a suitable and efficient respirator provided and maintained by the employer; unless the mixing is performed in a closed machine or the materials are in such a condition that no dust is produced.

Each respirator shall bear the distinguishing mark of the worker to whom it is supplied.

12. *Ventilation.*—All drying stoves as well as all workshops and all parts of factories shall be effectually ventilated to the reasonable satisfaction of the inspector in charge of the district.

13. *Lavatories.*—The occupier shall provide and continually maintain sufficient and suitable washing conveniences for all persons employed in the processes included in Schedule A, as near as practicable to the places in which such persons are employed.

The washing conveniences shall comprise soap, nail-brushes and towels, and at least one wash-hand basin for every five persons employed as above, with a constant supply of water laid on, with one tap at least for every two basins, and conveniences for emptying the same and running off the waste water on the spot down a waste-pipe.

There shall be in front of each washing basin, or convenience, a space for standing room which shall not be less in any direction than 21 inches.

14. *Cleansing of Work Places.*—The occupier shall see that the floors of workshops and of such stoves as are entered by the workpeople are sprinkled and swept daily; that all dust, scraps, ashes and dirt are removed daily, and that the mangles, work-benches, and stairs leading to workshops are cleansed weekly.

When so required by the inspector in charge of the district, by notice in writing, any such floors, mangles, work-benches and stairs shall be cleansed in such manner and at such times as may be directed in such notice.

As regards every potters' shop and stove, and every place in which any process included in Schedule A is carried on, the occupier shall cause the sufficient cleansing of floors to be done at a time when no other work is being carried on in such room, and in the case of potters' shops, stoves, dipping-houses, and majolica-painting rooms, by an adult male

Provided that in the case of rooms in which ground laying or glost placing is carried on, or in the china dippers' drying-room, the cleansing prescribed by this rule may be done before work commences for the day, but in no case shall any work be carried on in the room within one hour after any such cleansing as aforesaid has ceased.

15. *Boards.*—The occupier shall cause the boards used in the dipping-house, dippers' drying-room, or glost-placing shop to be cleansed every week, and shall not allow them to be used in any other department, except after being cleansed.

When so required by the inspector in charge of the district, by notice in writing, any such boards shall be washed at such times as may be directed in such notice.

Duties of Persons employed.

16. *Monthly Examination.*—All women and young persons employed in the processes included in Schedule A shall present themselves at the appointed time for examination by the certifying surgeon as provided in Rule 6 as amended.

No person after suspension by the certifying

surgeon shall work in any process included in the Schedule without a certificate of fitness from the certifying surgeon entered in the register.

17. *Overalls.*—Every person employed in any process included in Schedule A, or in emptying china biscuit ware, shall, when at work, wear a suitable overall and head-covering, and also a respirator when so required by Rule 11 as amended, which shall not be worn outside the factory or workshop, and which shall not be removed therefrom except for the purpose of being washed or repaired. Such overall and head-covering shall be in proper repair and duly washed.

The hair must be so arranged as to be fully protected from dust by the head-covering.

The overalls, head-coverings and respirators when not being worn, and clothing put off during working hours, shall be deposited in the respective places provided by the occupier for such purposes under Rule 8 as amended.

18. *Food.*—No person shall remain during meal-times in any place in which is carried on any process included in Schedule A, or introduce, keep, prepare, or partake of any food or drink, or tobacco therein at any time.

19. *Ventilation, Dust.*—No person shall in any way interfere, without the knowledge and concurrence of the occupier or manager, with the means and appliances provided by the employers for the ventilation of the workshops and stoves, and for the removal of dust.

20. *Washing.*—No person included in any process included in Schedule A shall leave the works or partake of meals without previously and carefully cleaning and washing his or her hands.

No person employed shall remove or damage the washing basins or conveniences provided under Rule 13.

20*a*. The persons appointed by the occupiers shall cleanse the several parts of the factory regularly as prescribed in Rule 14.

Every worker shall so conduct his or her work as to avoid, as far as practicable, making or scattering dust, dirt, or refuse, or causing accumulation of such.

21. *Boards.*—The boards used in the dipping-house, dippers' drying-room, or glost-placing shop shall not be used in any other department, except after being cleansed, as directed in Rule 15.

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22. *Disuse of Lead.*—If the occupier of a factory to which these rules apply gives with reference to any process included in Schedule A, other than china scouring, an undertaking that no lead or lead compound or other poisonous material shall be used, the chief inspector may approve in writing of the suspension of the operation of Rules 4, 5, 6, 7, 8, 15, 16, 17 and 21, or any of them in such process; and thereupon such rules shall be suspended as regards the process named in the chief inspector's approval, and in lieu thereof the following rule shall take effect, viz., No lead or lead compound or other poisonous material shall be used in any process so named.

For the purpose of this rule materials that contain no more than 1 per cent. of lead shall be regarded as free from lead.

SCHEDULE A.

Dipping or other process carried on in the dipping-house,

Glaze blowing,

Painting in majolica or other glaze,

Drying after dipping,

Ware cleaning after the application of glaze by dipping or other process,

China scouring,

Glost placing,

Ground laying,

Colour dusting } whether on-glaze or under-glaze.
Colour blowing }

Lithographic transfer making,

Making or mixing of fritts, glazes, or colours containing lead.

Any other process in which materials containing lead are used or handled in the dry state, or in the form of spray, or in suspension in liquid other than oil or similar medium.

Effect of Award Code of 1901.

The principal changes introduced by this code consisted in the strengthening of the ware-cleaning rule, the inclusion of colour blowing in the schedule of dangerous processes, and attention to certain minor points such as the cleaning of mangles.

In the two years (1902-3) under the Award Rules of 1901 the lead poisoning cases were appreciably fewer than in 1901.

	Males.	Females.	Total.
Last year of old code, 1901 -	57	49	106
New code, 1902 - - -	40	47	87
„ 1903 - - -	43	54	97

It will be noted, however, that the reduction of the total cases is entirely due to the smaller numbers of men attacked.

Arbitration Re-opened in 1903.

The adjournment of the proposed Rules 1 and 2 had been resolved upon largely in order that time might be given for the manufacturers to evolve a scheme of compensation for lead poisoning as an alternative to the compulsory use of low solubility glazes.

After a further brief adjournment from May 16th, 1903, the Arbitration Court assembled again on November 30th, 1903, and heard further evidence regarding the Rules 1 and 2 as proposed by the Home Office, and regarding the alternative of workmen's compensation for lead poisoning which had been inaugurated in the meantime, as a voluntary scheme, by a mutual society of manufacturers known as the Potters' Insurance Company.

Umpire's Final Award of 1903.

In December, 1903, Lord James of Hereford's Final Award was made and inaugurated: (1) Compulsory compensation for lead poisoning contracted in pottery work; (2) monthly medical examination of adult male lead workers. These rules to apply to every factory in regard to which the occupier gave notice of his intention to use glazes containing more than 5 per cent. of soluble lead.

Mr. Chester Jones again made an Award in identical terms to apply to those firms who had accepted him as sole Arbitrator.

SPECIAL RULES OF DECEMBER, 1903.

As established by Lord James of Hereford's Final Award.

Rule 1 was "deleted," and the new provisions just referred to were embodied in a new Rule 2 and Schedule B, worded as follows:—

2. After the first day of February, 1904, no glaze shall be used which yields to a dilute solution of hydrochloric acid more than five per cent. of its dry weight of a soluble lead compound calculated as lead monoxide when determined in the manner described below.

> A weighed quantity of dried material is to be continuously shaken for one hour, at the common temperature, with 1,000 times its weight of an aqueous solution of hydrochloric acid containing 0·25 per cent. of H.Cl. This solution is thereafter to be allowed to stand for one hour and to be passed through a filter. The lead salt contained in an aliquot portion of the clear filtrate is then to be precipitated as lead sulphide and weighed as lead sulphate.

If any occupier shall give notice in writing to the inspector for the district that he desires to use a glaze which does not conform to the above-mentioned conditions, and to adopt in his factory the scheme of compensation prescribed in Schedule B and shall affix and keep the same affixed in his factory, the above provisions shall not apply to his factory but instead thereof the following provisions shall apply.

All persons employed in any process included in Schedule A, other than china scouring, shall be examined before the commencement of their employment or at the first subsequent visit of the certifying surgeon, and once in each calendar month by the certifying surgeon of the district.

The certifying surgeon may at any time order by signed certificate the suspension of any such person from employment in any process included in Schedule A other than china scouring, if such certifying surgeon is of opinion that such person by continuous work in lead will incur special danger from the effects of plumbism, and no person after such suspension shall be allowed to work in any process incuded in Schedule A other than china scouring without a certificate of fitness from the certifying surgeon entered in the register.

Any workman who, by reason of his employment being intermittent or casual, or of his being in regular employment for more than one employer, is unable to present himself regularly for examination by the certifying surgeon, may procure himself at his own expense to be examined once a month by a certifying surgeon, and such examination shall be a sufficient compliance with this rule. The result of such examination shall be entered by the certifying surgeon in a book to be kept in the possession of the workman. He shall produce and show the said book to a factory inspector or to any employer on demand, and he shall not make any entry or erasure therein.

If the occupier of any factory to which this rule applies fails duly to observe the conditions of the said scheme, or if any such factory shall by reason of the occurrence of cases of lead poisoning appear to the Secretary of State to be in an unsatisfactory condition, he may, after an enquiry, at which the occupier shall have an opportunity of being heard, prohibit the use of lead for such time and subject to such conditions as he may prescribe.

All persons employed in the processes included in Schedule A other than china scouring shall present themselves at the appointed time for examination by the certifying surgeon, as prescribed in this rule.

In addition to the examinations at the appointed times, any person so employed may at any time present himself to the certifying surgeon for examination, and shall be examined on paying the prescribed fee.

All persons shall obey any directions given by the certifying surgeon.

No person after suspension by the certifying surgeon shall work in any process included in Schedule A other than china scouring without a certificate of fitness from the certifying surgeon entered in the register. Any operative who fails without reasonable cause to attend any monthly examination shall procure himself, at his own expense, to be examined within 14 days thereafter by the certifying surgeon, and shall himself pay the prescribed fee.

A register in the form which has been prescribed by the Secretary of State for use in earthenware and china works shall be kept, and in it the certifying surgeon shall enter the dates and results of his visits, the number of persons examined, and particulars of any directions given by him. This register shall contain a list of all persons employed in the processes included in Schedule A, or in emptying china biscuit ware, and shall be produced at any time when required by His Majesty's Inspector of Factories or by the certifying surgeon.

Schedule B.

Notice to workmen employed in processes named in Schedule A, other than china scouring. These conditions of compensation must be kept affixed in the factory to which they apply.

Conditions of Compensation.

1. Where a workman is suspended from working by a certifying surgeon of the district on the ground that he is of opinion that such person by continued work in lead will incur special danger from the effects of plumbism, and the certifying surgeon shall certify that in his opinion he is suffering from plumbism arising out of his employment, he shall, subject as hereinafter mentioned, be entitled to compensation from his employer as hereinafter provided.

   (a) If any workman who has been suspended as aforesaid dies within nine calendar months from the date of such certificate of suspension, by reason of plumbism contracted before the said date, there shall be paid to such of his dependants as are wholly dependant upon his earnings at the time of his death or upon the weekly compensation payable under this scheme, a sum equal to the amount he has earned during a period of three years next preceding the date of the said certificate, such sum not to be more than £300 nor less than £150 for an adult male, £100 for an adult female, and £75 for a young person.

   (b) If the workman does not leave any dependants wholly dependant as aforesaid, but leaves any dependants in part dependant as aforesaid, a reasonable part of that sum.

   (c) If he leaves no dependants, the reasonable expenses of his medical attendance and burial, not exceeding ten pounds.

2. With respect to such payments the following provisions shall apply:—

   (a) All sums paid to the workmen as compensation since the date of the said certificate shall be deducted from the sums payable to the dependants.

   (b) The payment shall, in case of death, be made to the legal personal representative of the workman, or, if he has no legal personal representative, to or for the benefit of his dependants, or, if he leaves no dependants, to the person to whom the expenses are due; and if made to the legal personal representative shall be paid by him to or for the benefit of the dependants or other person entitled thereto.

   (c) Any question as to who is a dependant, or as to the amount payable to each dependant, shall in default of agreement be settled by arbitration as hereinafter provided in Clause 9.

   (d) The sum allotted as compensation to a dependant may be invested or otherwise applied for the benefit of the person entitled thereto, as agreed, or as ordered by the arbitrator.

   (e) Any sum which is agreed or is ordered by the arbitrator to be invested may be invested in whole or in part in the Post Office Savings Bank.

3. Where a workman has been suspended and certified as provided in Condition 1, and while he is totally or partially prevented from earning a living by reason of such suspension, he shall be entitled to a weekly payment not exceeding fifty per cent of his average weekly earnings at the time of such suspension, such payment not to exceed £1. The average may be taken over such period, not exceeding 12 months, as appears fair or reasonable having regard to all the circumstances of the case.

4. In fixing these weekly payments, regard shall be had to the difference between the amount of the average weekly earnings of the workman at the time of his suspension and the average amount, if any, which is estimated that he will be able to earn afterwards in any occupation or employment, and to any payments (not being wages) which he may have received from the employer in respect of the suspension, and to all the circumstances of the case, including his age and expectation of life.

5. If it shall appear that any workman has persistently disobeyed the special rules or the directions given for his protection by his employers, and that such disobedience has conduced to his suspension, or has not presented himself for examination by the certifying surgeon, or has failed to give full information and assistance as provided in Condition 6, his conduct may be taken into consideration in assessing the amount of the weekly payments.

6. It shall be the duty of every workman at all times to submit to medical examination when required and to give full information to the certifying surgeon and to assist to the best of his power in the obtaining of all facts necessary to enable his physical condition to be ascertained.

7. Any weekly payment may be reviewed at the request either of the employer or of the workman, and on such review may be ended, diminished, or increased, subject to the maximum above provided, and the amount of payment shall, in default of agreement, be settled by arbitration.

8. Any workman receiving weekly payments under this scheme shall submit himself if required for examination by a duly qualified medical practitioner provided and paid by the employer.

If the workman refuses to submit himself to such examination or in any way obstructs the same, his right to such weekly payments shall be suspended until such examination has taken place.

9. If any dispute shall arise as to any certificate of the certifying surgeon or as to the amount of compensation payable as herein provided, or otherwise in relation to these provisions, the same shall be decided by an arbitrator to be appointed by the employer and workman, or in default of agreement by the Secretary of State. The said arbitrator shall have all the powers of an arbitrator under the Arbitration Act, and his decision shall be final.

The fee of the arbitrator shall be fixed by the Secretary of State, and shall be paid as the arbitrator shall direct.

10. No compensation shall be payable under these provisions unless notice of claim in writing is made within six weeks of the date of the certificate of suspension, or of the death, provided that the want of such notice shall not bar the claim if in the opinion of the arbitrator there was reasonable excuse for the want of it.

A claim for compensation by any workman whose employment is intermittent, or casual, or who is regularly employed by more than one employer, shall only arise against the employers for whom he has worked in a process included in Schedule A within one month prior to his suspension. The said employers shall bear the compensation among them in such proportion as in default of agreement shall be determined by an arbitrator as herein provided.

11. "Employer" includes an occupier, a corporation, and the legal representatives of a deceased employer. "Workman" includes every person, male or female, whether his agreement be one of service or apprenticeship or otherwise, and is expressed or implied, orally or in writing, and shall include the personal representatives of a deceased workman. "Dependants" has the same meaning as in the Workmen's Compensation Act, 1897.

The terms contained in this notice shall be deemed to be part of the contract of employment of all workmen in the above named processes.

Occupier's Signature ....

....

Rules 3 to 22 were unaltered.*

Exemptions under the Award Code.

In addition to Rule 22, which provided for certificates of exemption from certain rules in the case of potteries, or departments of potteries, where leadless materials were exclusively used, provision was also made, with the concurrence of the umpire, for relaxing the age limit of 15 in regard to scheduled processes in works where no glaze containing more than 2 per cent. of soluble lead was used.

Furthermore, although Rule 10 prescribed exhaust draught for all ware cleaning, the umpire contemplated the relaxation of this requirement in places where low solubility glazes were used, and also where this operation was conducted in such a way as to avoid dust, it being obviously desirable to encourage wet methods of ware cleaning, wherever possible. Application for such exemptions was invited, and many firms availed themselves of them.

Lastly, it was found desirable to frame a rule to apply to potteries whose occupiers wished to adopt a moist method of ware cleaning for part only of their products, the remainder being cleaned dry with the use of an exhaust draught.

The supplementary rules dealing with these special exemptions were numbered 23 to 25, and read as follows:—

SUPPLEMENTARY SPECIAL RULES FOR THE MANUFACTURE OF EARTHENWARE AND CHINA IN FORCE IN CERTAIN WORKS.

23. If the occupier of any factory to which these rules apply gives an undertaking in writing either to the effect that

(a) no glaze shall be used which yields to a dilute solution of hydrochloric acid more than 5 per cent. of its dry weight of a soluble lead compound calculated as lead monoxide when determined in the manner described in Rule 2, paragraph 2;

or to the effect that

(b) no ware shall be cleaned after the application of glaze by dipping or other process except in the moist condition;

the Chief Inspector of Factories may, if satisfied that the other conditions are sufficient for the safety of the persons employed, approve in writing of the suspension in the factory or part of the factory of so much of Rule 10 as requires the provision of a fan or other efficient means, to be approved by the Secretary of State, for the removal of dust in the process of ware cleaning; and thereupon the said part of Rule 10 shall be suspended accordingly, and the said undertaking shall be deemed to be a special rule established in the factory.

24. If the occupier of any factory to which these rules apply gives an undertaking in writing to the effect that no glaze shall be used which yields to a dilute solution of hydrochloric acid more than 2 per cent. of its dry weight of a soluble lead compound calculated as lead monoxide when determined in the manner described in Rule 2, paragraph 2, the Chief Inspector of Factories may, if satisfied that the other conditions are sufficient for the safety of the persons employed, approve in writing of the modification of Rule 5 in so far as it applies to the processes of dipping, drying after dipping, and ware cleaning, in the factory or part of the factory, by the substitution of 14 years for 15 years of age, and thereupon Rule 5 shall be modified accordingly, and the said undertaking shall be deemed to be a special rule established in the factory.

Any approval granted under Rules 23 and 24 is liable to revocation in case it shall appear to the Secretary of State that, owing to the occurrence of lead poisoning in any factory, such revocation is desirable.

25. No ware shall be cleaned after the application of glaze by dipping or other process, except in the moist state, or with damp sponge or other similar damp material, or with the use of an efficient exhaust draught.

So much of Rule 10 as requires the provision of a fan or other efficient means for the removal of dust in the process of ware cleaning after the dipper shall not apply.

Lead Poisoning Cases under the Award Code of 1903.

The following table shows the number of cases of lead poisoning in each year since the date of Lord James of Hereford's Final Award:—

Year.	Males.	Females.	Total.
1904 - - -	39	67	106
1905 - - -	36	48	84
1906 - - -	47	60	107
1907 - - -	52	51	103
1908 - - -	56	61	117
1909 - - -	28	30	58

These figures indicate but little change in the years 1904-7 as compared with years immediately preceding 1904; in the year 1908, however, there was a marked increase, connected apparently, in some manner, with the period of industrial activity which covered the latter months of 1907 and a great part of 1908; while the figures for 1909, the last completed year, show a very gratifying reduction to one-half the number of cases in the preceding year.

Factory and Workshop Act, 1901.

In the year 1901 a general Act was passed, consolidating the provisions of the Acts of 1878, 1891, and 1895. Certain fresh requirements were also embodied in the new Act, such as the exclusion of all persons at meal-times from places where lead, arsenic, or other poisonous substance is used in such a manner as to give rise to dust or fumes, and the provision for persons so excluded from such places of suitable accommodation at meal-times elsewhere in the factory or workshop. There were also included in this Act important new requirements as to steam-boilers and other matters.

Regulations for Dangerous Trades.

So far as the pottery industry is concerned, however, the most important change introduced by the

* See pages 18 to 20.

Act of 1901 was the substitution of Regulations for Special Rules as a means of enacting special precautions in certified dangerous trades. Whereas Special Rules under the Acts of 1891 and 1895 apply only to the individual works in which they are established, and are subject to arbitration in each case, if objections are taken and pressed, Regulations under section 79 of the Act of 1901 apply automatically to all works indicated in the Order of the Secretary of State making the Regulations in question, and modification of the requirements in individual cases is not permissible unless such powers are expressly provided in the code itself.

The sections of the Acts of 1891 and 1895 which give validity to existing codes of special rules are temporarily retained in force, with a provision for their repeal from a date to be fixed by Order of the Secretary of State; but in all new codes the procedure is that laid down by sections 79 and 86 of the Act of 1901. Section 83 of this Act, in setting forth the provisions which may, among others, be made by regulations, recapitulates the object for which Special Rules could be issued under the previous Acts, and adds that Regulations may prohibit, limit or control the use of any material or process; and modify or extend any special regulation for any class of factories or workshops contained in this Act. The method of arbitration is abandoned, and provision is made for the holding of a public inquiry in cases where serious objections to a draft code are persisted in, and no compromise is secured. When Regulations are finally made by Order of the Secretary of State they are laid before both Houses of Parliament for forty days, after which, except in so far as provisions may be annulled by resolution in either House, the Code becomes operative in respect of all works included in the terms of the Order.

Workmen's Compensation Act, 1906.

On July 1st, 1907, the Workmen's Compensation Act of 1906 came into force and provided for payment of compensation to all persons who contracted lead poisoning as a result of their employment in factories and workshops. This measure rendered Schedule B of the Award Code of 1903 to a large extent redundant. This was the last legislative change, specially affecting potteries, prior to the appointment of the present Committee in May, 1908.

APPENDIX II.

PERSONS EMPLOYED IN 1907 IN POTTERIES UNDER SPECIAL RULES.

Table supplied by H.M. Chief Inspector of Factories to accompany his evidence.

Class of Workers.	North Staffordshire Potteries.		Rest of United Kingdom.		Total.		
	Males.	Females.	Males.	Females.	Males.	Females.	M. and F.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
In lead processes:—							
Dippers	504	107	282	43	786	150	936
Dippers' assistants	368	257	95	140	463	397	860
Ware cleaners	91	396	24	65	115	461	576
Glost placers	1,853	80	438	40	2,291	120	2,411
Majolica painters	7	387	21	71	28	458	486
Ground layers	50	145	8	12	58	157	215
Colour and litho. dusters	13	118	1	25	14	143	157
Enamel colour and glaze blowers	45	278	6	10	51	288	339
Colour makers and millers, and mixers of glaze or colour	227	48	144	7	371	55	426
Other	213	112	114	20	327	132	459
	3,371	1.928	1,133	433	4.504	2,361	6,865
In processes not involving exposure to lead	20,194	21,973	9,104	4,710	29,298	26,683	55,981
	23,565	23,901	10,237	5,143	33,802	29,044	62,846
Factories	317		219		536		

APPENDIX III.

GLAZE SAMPLES.

Table, supplied by H.M. Chief Inspector of Factories, showing the number of samples of glazes taken by H.M. Inspectors of Factories and analysed for the purpose of testing the observance of undertakings given by certain firms in regard to limitation in the amount of lead used.

Rule, and limitation of Lead.	1904.	1905.	1906.	1907.
Rule 24: 2 per cent. Lead Monoxide, soluble	2^{1}	2^{2}	—	1^{0}
Rule 23a: 5 per cent. Lead Monoxide, soluble	41^{13}	35^{9}	4^{1}	33^{8}
Rule 22: "Leadless Ware," 1 per cent. Lead	27^{2}	34^{4}	1^{1}	50^{5}
	70^{16}	71^{15}	5^{2}	84^{13}

The main figures are those of all samples; the small figures those in which excess was found.

APPENDIX IV.

EARTHENWARE AND CHINA: LEAD POISONING.

Table supplied by H.M. Chief Inspector of Factories.

Year.	Reported Cases in		Whole of United Kingdom.
	North Staffs. District.	Rest of United Kingdom.	
1896	432		432
1897	446		446
1898	348	109	457
1899	204	45	249
1900	165	35	200
1901	84	22	106
1902	66	21	87
1903	75	22	97
1904	84	22	106
1905	75	9	84
1906	85	22	107
1907	82	21	103
1908	91	26	117
1909	49	9	58

APPENDIX V.

ANALYSIS OF LEAD POISONING CASES, 1907, ACCORDING TO PROCESS.

Table supplied by H.M. Chief Inspector of Factories.

Processes.		North Staffordshire District only.			Whole of the United Kingdom (including the North Staffordshire District).		
		Persons employed.	Cases.	Attack rate per 1,000 employed.	Persons employed.	Cases.	Attack rate per 1,000 employed.
In Dipping House—							
Dippers-	M.	504	17	34	786	21	27
	F.	107	4	37	150	6	40
Dippers' assistants	M.	368	1	3	463	1	2
	F.	257	8	31	397	13	33
Ware cleaners	M.	91	—	—	115	—	—
	F.	396	17	43	461	17	37
Total	M.	963	18	19	1,364	22	16
	F.	760	29	38	1,008	36	36
Glost placers	M.	1,853	14	8	2,291	21	9
	F.	80	1	12	120	1	8
Majolica painters-	M.	7	—	—	28	—	—
	F.	387	3	8	458	4	9
Ground layers	M.	50	—	—	58	—	—
	F.	145	1	7	157	1	6
Colour and litho. dusters	M.	13	—	—	14	—	—
	F.	118	—	—	143	—	—
Enamel, colour and glaze blowers	M.	45	—	—	51	—	—
	F.	278	6	22	288	7	24
Colour makers and millers and mixers of glaze or colour	M.	227	5	22	371	5	13
	F.	48	1	21	55	1	18
Other persons in contact with lead	M.	213	3	14	327	4	12
	F.	112	1	9	132	1	8
Grand Total-	M.	3,371	40	12	4,504	52	12
	F.	1,928	42	22	2,361	51	22
	M.&F.	5,299	82	15	6,865	103	15

APPENDIX VI.

ABSTRACT OF A REPORT ON LE SATURNISME EXPERIMENTAL, par le DR. D. GLIBERT, Inspecteur-médecin Principal, attaché à l'Administration Centrale. Extrait des Rapports annuels de l'Inspection du Travail de Belgique en 1906.

Lead acts sometimes in clearly defined manner, more often insidiously, and it is the more to be feared, because the effects are often unrecognised by its victims, and occasionally by medical men.

With the greater attention now directed to chronic lead poisoning, the numerous difficulties in the way of an early diagnosis become more prominent.

This experimental inquiry was undertaken for the purpose of studying the symptoms and pathology of poisoning by salts of lead. The objects were (1) to determine the rapidity and mode of action of salts of lead when ingested in varying amount; (2) to study the effect of these doses on the organs and more especially on the blood; and (3) to note the degree of constancy with which certain symptoms could be regarded as almost pathognomonic.

Known quantities of white lead were given in food to animals, because this method resembled most the manner in which plumbism is usually brought about in man. The animals were examined and weighed every day. The red and white corpuscles were counted and the hæmoglobin estimated, and blood was taken for microscopical examination every ten days.

[Then follows the "protocol" of each of 28 guinea-pigs.]

CLINICAL RESULTS OF EXAMINATION.

Very marked variation in individual resistance was shown—at times quite feeble doses brought about relatively rapid poisoning.

Tendency to abort was pronounced—a cause of death for the mother and newly-born. "These accidents, common enough, it is true among guinea-pigs generally, were so frequent during the inquiry, that they must impose on us the greatest circumspection when there is a question of the admission of women in certain processes necessitating use of lead salts."

Richness of the blood in hæmoglobin.—Examination of the results in this respect shows that a diminution in percentage of hæmoglobin is almost constant in chronic experimental lead poisoning. It is observed also in sub-acute plumbism, but here it does not come into prominence so much as in prolonged cases of lead absorption. Animals intoxicated by big doses succumb usually before the blood-colouring matter has had time to undergo any intense change. Further, if the poisoning process is interrupted, usually the defensive mechanism suffices to repair fairly quickly the loss of hæmoglobin in the blood. But, whatever the dose administered, and however regularly this is done, the diminution does not proceed in a uniform way. There is an early marked drop in the percentage. This early drop often reaches, and sometimes exceeds, that almost invariably found during the last few weeks of life.

This fact seems to have important practical bearing on periodical medical inspection of lead workers. Determination of the percentage of hæmoglobin, periodically and regularly, in those who have commenced work in lead processes, can give precise indications as to their resistance and as to threatened attacks.

After the initial drop there is a reaction, and the hæmoglobin goes up until an equilibrium is established, which continues until the final fall.

Red blood cells.—The following figures give the number of red blood cells:—

Guinea Pigs.	Dose.	Number.		Difference.
		First Count.	Last Count.	
I. - -	1 mg.	5,790,000	4,235,000	1,555,000
VI. - -	1 cg.	4,785,000	3,530,000	1,255,000
X. - -	5 cg.	5,455,000	3,330,000	2,125,000
XV. - -	50 cg.	5,505,000	3,880,000	1,625,000

Generally speaking the number falls, but as in the case of hæmoglobin the reduction does not proceed uniformly. There is the same initial drop, followed by recovery up to a certain point. But this diminution and recovery does not by any means always synchronise with the diminution and recovery of the hæmoglobin, and therefore it has less value from the practical side.

Hæmolysis.—This did not present itself with such degree of constancy as to constitute an important element in diagnosis.

Ductility of the red blood cells.—A diminution in ductility seems characteristic of the red cells of saturnine blood when examined fresh. It varies with the degree of intoxication and often only a limited number is affected. Sometimes, however, it is so pronounced, that the majority appear like discs of an almost perfect rigidity.

We think it desirable to call special attention to this point, for probably it constitutes one of the very earliest signs of lead intoxication. The blood of guinea-pigs shows it well—that of rabbits does not. In man, if it cannot with certainty be regarded as an early sign, it is rarely absent in a genuine case of lead poisoning. The symptom is transitory, and disappears rapidly on cessation of absorption of the poison. In judging of the phenomenon experience and practice are necessary. Our method has been to collect a drop of blood on the point of a needle, to smear then a slide and cover it with a cover-glass. In this way bubbles of air are imprisoned in the blood, and on examining with the microscope that part of the preparation at the edge, where the blood flows slowly, a certain number of corpuscles are seen impinging on the bubbles without showing the momentary alteration in shape characteristic of normal cells.

Size and alteration of the red cells.—The average diameter is generally increased. Megalocytes and microcytes are frequently observed. Poikilocytosis is not rare; but these characters are usually late in appearance and do not seem of capital importance for diagnosis. They occur in other disorders of blood origin. Similarly with regard to nucleated red cells, and presence of normoblasts, microblasts, and megaloblasts.

In lead workers nucleated red cells are never found before plumbism is so advanced as already to have claimed serious attention.

Basophile granules in the red cells.—The frequency of this phenomenon is no longer contested, but it cannot be regarded as specific of lead poisoning. But basophile granules do not appear in any other condition so quickly and in such abundance as in lead poisoning. Their presence, then, is strong presumptive evidence of plumbism and is to be regarded as a very important point in diagnosis.

The author suggests from the close relationship which is found between existence of ductility and presence of basophile granules that the two things are merely manifestations of one and the same condition, i.e., that it is the red cell containing basophile granules which loses its power of elasticity.

Polychromatophil cells are very constantly present, and the number found is in proportion to the stage of poisoning reached.

White blood cells.—All the blood counts showed most energetic leucocytic reaction from the commencement of the poisoning. From the differential count (i.e., the relative numbers of different kinds of white blood cells present in the blood) at the commencement and end of the experiments, the most remarkable fact is the great diminution in the polynuclear elements and increase in lymphocytes. This point the author regards as so important that it is to be followed up by other experiments.

Microscopical examination of the organs after death was made in the case of 16 guinea-pigs. Changes in the liver were found in 14, of the kidney also in 14, of the lungs in 12, of the heart in 9, of the spleen in 9, and of the nervous system in 4. Often the same animal had several organs affected.

The most unexpected result was the extreme frequency of disease of the respiratory tract, and it is

remarkable that the serious lesions are set up by long continued action of medium or large doses rather than of small ones. The extreme frequency of this condition raises the suspicion that lead plays a part in the causation of respiratory disease (common enough in certain classes of lead workers), either by the lead itself giving rise to the sclerosis, or by the debility induced by its action so diminishing the resistance of the broncho-pulmonary tissues to external injurious agents.

As regards changes in the nervous system of practical interest is the fact that it is large doses which most often give rise to epileptic seizures. In certain industries fatal cases of encephalopathy occasionally occur within a few days of the examination of the victims who may then have shown no traces of plumbism. In such cases obviously inquiry should be made as to whether some particularly dangerous work had not been done, such as sweeping out the workroom, cleaning ducts, etc.

Practically no relation was found between the duration of intoxication and the extent of the lesions found.

Conclusions.

A. *Clinical.*

Very great individual differences in susceptibility are observed—appreciable from the first.

The proportion of hæmoglobin in the blood always diminishes at first. This is an almost absolute rule. It is the same with the number of the red blood cells, but this diminution is not absolutely parallel with the diminution in the proportion of hæmoglobin.

In general, the blood count shows notable variation.

Often in the case of slow saturnine intoxication a state of equilibrium—with diminished proportion of hæmoglobin and diminution in number of red cells—which lasts a long time, is noted.

Basophile granules in the red blood cells are constant features during absorption of lead. They appear generally very early and disappear when the poison is withheld.

A diminution in the ductility of the red blood cells is constant in the guinea-pig during the progress of the poisoning. Its commencement often coincides with the appearance of basophile granules and disappears with them.

The number of the white blood cells is increased, and the differential count becomes inverted.

Large doses of poison favour explosion of encephalopathic symptems.

B. *Microscopic.*

The lesions produced are parenchymatous, interstitial, and congestive.

The organs most frequently affected are the liver and kidneys.

The respiratory tract is almost as frequently affected as those mentioned.

Very small doses appear to have action limited only to the liver.

T. M. L.

APPENDIX VII.

Lead Poisoning Cases, 1899–1909, in Factories under Earthenware and China Special Rules, classified according to the various branches of the Industry.

Whole of United Kingdom (including North Staffordshire District).

Tables compiled from Home Office Records.

Note.—The attack rates for the years 1899 to 1905 are calculated on the numbers of persons employed in 1904; the attack rates for 1906 to 1909 are calculated on the numbers employed in 1907.

Introduction of the most notable changes of rules indicated in the body of the tables.

GENERAL TABLE.

ALL LEAD WORKERS in places under Earthernware and China Special Rules. Whole of United Kingdom (including North Stafford).

Number of persons employed.

Year		China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture and Electrical Fittings.	Sanitary.	Totals.	Totals. M. & F.
1904 -	- M.	536	2,751	557	100	216	44	190	4,394	6,694
	F.	238	1,122	562	110	71	158	39	2,300	
1907 -	- M.	625	2,835	474	96	171	66	237	4,504	6,865
	F.	302	1,111	487	170	70	179	42	2,361	

Number of cases of lead poisioning.

Year		China. Cases.	China. Attack rate per 1,000.	Earthenware. Cases.	Earthenware. Attack rate per 1,000.	Tiles. Cases	Tiles. Attack rate per 1,000.	Majolica. Cases.	Majolica. Attack rate per 1,000.	Jet and Rockingham. Cases	Jet and Rockingham. Attack rate per 1,000.	China Furniture and Electrical Fittings. Cases	China Furniture and Electrical Fittings. Attack rate per 1,000.	Sanitary. Cases	Sanitary. Attack rate per 1,000.	Totals. Total Cases.	Totals. Attack rate per 1,000.	Total Cases. M. & F.	Attack rate per 1,000.
1899	- M.	13	24	106	39	7	13	2	20	—	—	—	—	—	—	128	29	249	37
	F.	8	34	83	74	21	37	4	36	—	—	5	32	—	—	121	53		
1900	- M.	11	21	62	23	12	22	3	30	5	23	1	23	1	5	95	22	200	30
	F.	10	42	67	60	15	27	2	18	—	—	11	70	—	—	105	46		
1901	- M.	7	13	37	13	9	16	—	—	3	14	1	23	—	—	57	13	106	16
	F.	2	8	28	25	7	12	2	18	1	14	9	57	--	—	49	21		
Lord James's Code—Rule 3 onwards—came into force.																			
1902	- M.	3	6	30	11	6	11	—	—	—	—	—	—	1	5	40	9	87	13
	F.	2	8	33	29	5	9	2	18	1	14	4	25	—	—	47	20		
1903	- M.	1	2	29	11	8	14	1	10	3	14	—	—	1	5	43	10	97	14
	F.	6	25	32	29	9	16	6	55	—	—	1	6	—	—	54	23		
Medical examination of men began.																			
1904	- M.	2	4	31	11	6	11	—	—	—	—	—	—	—	—	39	9	106	16
	F.	1	4	41	37	19	34	1	9	1	14	4	25	—	—	67	29		
1905	- M.	4	8	25	9	4	7	—	—	—	—	2	45	1	5	36	8	84	13
	F.	3	13	23	20	14	25	4	36	2	28	2	13	—	—	48	21		
1906	- M.	5	8	34	12	7	15	—	—	—	—	—	—	1	4	47	10	107	16
	F.	2	7	41	37	10	21	3	18	—	—	3	17	1	24	60	25		
1907	- M.	6	10	38	13	4	8	—	—	1	6	—	—	3	13	52	12	103	15
	F.	7	23	33	30	6	12	1	6	—	—	3	17	1	24	51	22		
1908	- M.	4	6	45	16	3	6	—	—	1	6	1	15	2	8	56	12	117	17
	F.	1	3	42	38	8	16	1	6	—	—	8	45	1	24	61	26		
1909	- M.	2	3	22	8	4	8	—	—	—	—	—	—	—	—	28	6	58	8
	F.	1	3	17	15	7	14	—	—	2	29	2	11	1	24	30	13		

SECTIONAL TABLE A.

MILLERS and MIXERS of glaze or colour; and COLOUR MAKERS. Whole of United Kingdom (including North Stafford).

Number of persons employed.

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture and Electrical Fittings.	Sanitary.	Totals.	Totals. M. & F.
1904—M.	46	200	91	22	9	4	4	376	397
F.	1	16	3	—	—	—	1	21	
1907—M.	50	188	91	14	8	4	16	371	426
F.	17	35	2	—	1	—	—	55	

Number of cases of lead poisoning.

	China.		Earthenware.		Tiles.		Majolica.		Jet and Rockingham.		China Furniture and Electrical Fittings.		Sanitary.		Totals.		Totals. M. & F.	
	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Total Cases.	Attack rate per 1,000.	Total Cases. M.&F.	Attack rate per 1,000.
1899—M.	—	—	7	35	2	22	—	—	—	—	—	—	—	—	9	24	9	23
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1900—M.	1	22	2	10	—	—	1	45	—	—	—	—	—	—	4	11	5	13
F.	—	—	1	62	—	—	—	—	—	—	—	—	—	—	1	48		
1901—M.	1	22	3	15	2	22	—	—	—	—	—	—	—	—	6	16	7	18
F.	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	48		
Millers and mixers of glazes first specially dealt with in the Special Rules.																		
1902—M.	—	—	3	15	2	22	—	—	—	—	—	—	—	—	5	13	6	15
F.	—	—	1	62	—	—	—	—	—	—	—	—	—	—	1	48		
1903—M.	—	—	2	10	2	22	—	—	—	—	—	—	—	—	4	11	4	10
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
Medical examination of men began.																		
1904—M.	1	22	1	5	2	22	—	—	—	—	—	—	—	—	4	11	4	10
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1905—M.	—	—	3	15	3	33	—	—	—	—	1		1		8	21	10	25
F.	—	—	2	125	—	—	—	—	—	—	—	—	—	—	2	95		
1906—M.	1	20	1	5	2	22	—	—	—	—	—	—	—	—	4	11	5	12
F.	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	48		
1907—M.	1	20	2	11	2	22	—	—	—	—	—	—	—	—	5	13	6	14
F.	1	59	—	29	—	—	—	—	—	—	—	—	—	—	1	48		
1908—M.	—	—	8	43	—	—	—	—	—	—	—	—	—	—	8	22	8	19
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1909—M.	—	—	1	5	3	33	—	—	—	—	—	—	—	—	4	11	4	9
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		

SECTIONAL TABLE B.

DIPPERS. Whole of United Kingdom (including North Stafford).

Number of persons employed.

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture and Electrical Fittings.	Sanitary.	Totals.	Totals. M. and F.
1904—M.	93	478	119	18	35	5	33	781	913
F.	—	47	47	2	2	34	—	132	
1907—M.	107	456	125	17	30	8	43	786	936
F.	8	41	52	18	4	27	—	150	

Number of cases of lead poisoning.

	China.		Earthenware.		Tiles.		Majolica.		Jet and Rockingham.		China Furniture and Electrical Fittings.		Sanitary.		Totals.		Totals. M. and F.	
	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Total Cases.	Attack rate per 1,000.	Total Cases. M.&F.	Attack rate per 1,000.
Under Special Rules from 1894.																		
1899—M.	5	54	30	63	2	17	1	56	—	—	—	—	—	—	38	49	55	60
F.	—	—	10	213	3	64	—	—	—	—	4	118	—	—	17	129		
1900—M.	4	43	20	42	5	42	1	56	5	143	—	—	1	30	36	46	41	45
F.	—	—	1	21	2	43	1		—	—	1	29	—	—	5	38		
1901—M.	2	22	11	23	4	34	—	—	1	29	1		—	—	19	24	23	25
F.	—	—	2	43	—	—	—	—	—	—	2	59	—	—	4	30		
1902—M.	—	—	9	19	2	17	—	—	—	—	—	—	—	—	11	14	15	16
F.	—	—	3	64	—	—	—	—	—	—	1	29	—	—	4	30		
1903—M.	—	—	11	23	2	17	—	—	2	57	—	—	1	30	16	20	17	19
F.	—	—	—	—	1	21	—	—	—	—	—	—	—	—	1	8		
Medical examination of men began.																		
1904—M.	1	11	15	31	4	34	—	—	—	—	—	—	—	—	20	26	28	31
F.	—	—	3	64	4	85	—	—	—	—	1	29	—	—	8	61		
1905—M.	1	11	11	23	—	—	—	—	—	—	—	—	—	—	12	15	16	18
F.	—	—	—	—	1	21	3		—	—	—	—	—	—	4	30		
1906—M.	4	37	14	31	5	40	—	—	—	—	—	—	—	—	23	29	28	30
F.	—	—	—	—	1	19	3	167	—	—	1	37	—	—	5	33		
1907—M.	4	37	14	31	—	—	—	—	—	—	—	—	3	70	21	27	27	29
F.	—	—	2	49	1	19	—	—	—	—	3	111	—	—	6	40		
1908—M.	1	9	15	33	2	16	—	—	—	—	1		1	23	20	25	27	29
F.	—	—	2	49	2	38	—	—	—	—	3	111	—	—	7	47		
1909—M.	1	9	12	26	1	8	—	—	—	—	—	—	—	—	14	18	18	19
F.	—	—	1	24	2	38	—	—	—	—	1	37	—	—	4	27		

SECTIONAL TABLE C.

DIPPERS' ASSISTANTS. Whole of United Kingdom (including North Stafford).

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture and Electrical Fittings.	Sanitary.	Totals.	Totals. M. & F.
Number of persons employed.									
1904—M.	70	283	56	5	24	2	14	454	841
F.	5	315	21	5	28	6	7	387	
1907—M.	77	298	56	3	12	1	16	463	860
F.	5	283	50	7	24	21	7	397	

Number of cases of lead poisoning.

	China. Cases.	China. Attack rate per 1,000.	Earthenware. Cases.	Earthenware. Attack rate per 1,000.	Tiles. Cases.	Tiles. Attack rate per 1,000.	Majolica. Cases.	Majolica. Attack rate per 1,000.	Jet and Rockingham. Cases.	Jet and Rockingham. Attack rate per 1,000.	China Furniture and Electrical Fittings. Cases.	China Furniture and Electrical Fittings. Attack rate per 1,000.	Sanitary. Cases.	Sanitary. Attack rate per 1,000.	Total Cases.	Attack rate per 1,000.	Total Cases. M.&F.	Attack rate per 1,000
Under Special Rules from 1894.																		
1899—M.	—	—	12	42	1	18	—	—	—	—	—	—	—	—	13	29	34	40
F.	3		17	54	1	48	—	—	—	—	—	—	—	—	21	54		
1900—M.	1	14	7	25	1	18	—	—	—	—	—	—	—	—	9	20	32	38
F.	—	—	19	60	—	—	—	—	—	—	4		—	—	23	59		
1901—M.	1	14	2	7	—	—	—	—	1	42	—	—	—	—	4	9	15	18
F.	—	—	7	22	—	—	—	—	—	—	4		—	—	11	28		
1902—M.	—	—	3	11	—	—	—	—	—	—	—	—	—	—	3	7	15	18
F.	—	—	11	35	—	—	—	—	1	36	—	—	—	—	12	31		
1903—M.	—	—	5	18	1	18	—	—	—	—	—	—	—	—	6	13	24	29
F.	—	—	17	54	—	—	1		—	—	—	—	—	—	18	47		
Medical examination of men began.																		
1904—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	20	24
F.	—	—	17	54	—	—	—	—	1	36	2		—	—	20	52		
1905—M.	—	—	4	14	—	—	—	—	—	—	—	—	—	—	4	9	19	23
F.	—	—	12	38	—	—	—	—	2	71	1		—	—	15	39		
1906—M.	—	—	4	13	—	—	—	—	—	—	—	—	—	—	4	9	23	27
F.	—	—	18	64	1	20	—	—	—	—	—	—	—	—	19	48		
1907—M.	—	—	1	3	—	—	—	—	—	—	—	—	—	—	1	2	14	16
F.	—	—	12	42	—	—	—	—	—	—	—	—	1		13	33		
1908—M.	—	—	6	20	—	—	—	—	—	—	—	—	—	—	6	13	25	29
F.	—	—	19	67	—	—	—	—	—	—	—	—	—	—	19	48		
1909—M.	—	—	1	3	—	—	—	—	—	—	—	—	—	—	1	2	10	12
F.	—	—	7	24	—	—	—	—	2	83	—	—	—	—	9	23		

SECTIONAL TABLE D.

WARE CLEANERS. Whole of United Kingdom (including North Stafford).

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture and Electrical Fittings.	Sanitary.	Totals.	Totals. M. & F.
Number of persons employed.									
1904—M.	65	27	—	—	3	—	6	101	545
F.	34	246	45	5	16	78	20	444	
1907—M.	60	40	—	—	2	—	13	115	576
F.	42	226	55	7	14	89	28	461	

Number of cases of lead poisoning.

	China. Cases.	China. Attack rate per 1,000.	Earthenware. Cases.	Earthenware. Attack rate per 1,000.	Tiles. Cases.	Tiles. Attack rate per 1,000.	Majolica. Cases.	Majolica. Attack rate per 1,000.	Jet and Rockingham. Cases.	Jet and Rockingham. Attack rate per 1,000.	China Furniture and Electrical Fittings. Cases.	China Furniture and Electrical Fittings. Attack rate per 1,000.	Sanitary. Cases.	Sanitary. Attack rate per 1,000.	Total Cases.	Attack rate per 1,000.	Total Cases. M.&F.	Attack rate per 1,000.
Under Special Rules from 1894.																		
1899—M.	3	46	—	—	—	—	—	—	—	—	—	—	—	—	3	30	36	66
F.	1	29	28	114	3	67	—	—	—	—	1	13	—	—	33	74		
1900—M.	4	62	2	74	—	—	—	—	—	—	—	—	—	—	6	59	50	92
F.	2	59	30	122	7	156	—	—	—	—	5	64	—	—	44	99		
1901—M.	—	—	—	—	1	7	—	—	—	—	—	—	—	—	1	10	24	44
F.	—	—	16	65	3	67	1		—	—	3	38	—	—	23	52		
Exhaust fans introduced in addition to water troughs.																		
1902—M.	2	31	—	—	—	—	—	—	—	—	—	—	—	—	2	20	21	39
F.	2	59	12	49	3	·67	—	—	—	—	2	26	—	—	19	43		
1903—M.	1	15	1	37	1		—	—	—	—	—	—	—	—	3	30	18	33
F.	3	88	9	37	2	44	1		—	—	—	—	—	—	15	34		
Medical examination of men began.																		
1904—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	26	48
F.	1	29	15	61	9	200	—	—	—	—	1	13	—	—	26	59		
1905—M.	1	15	1	37	—	—	—	—	—	—	1		—	—	3	30	17	31
F.	2	59	4	16	6	133	1		—	—	1	13	—	—	14	32		
1906—M.	—	—	—	—	—	—	—	—	—	—	—	—	1	77	1	9	19	33
F.	1	24	13	58	2	36	—	—	—	—	1	11	1	36	18	39		
1907—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	17	30
F.	3	71	12	53	2	36	—	—	—	—	—	—	—	—	17	37		
1908—M.	2	33	—	—	—	—	—	—	—	—	—	—	—	—	2	17	22	38
F.	1	24	13	58	1	18	—	—	—	—	4	45	1	36	20	43		
1909—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13	23
F.	1	24	8	36	2	36	—	—	—	—	1	11	1	36	13	28		

SECTIONAL TABLE E.

GLOST PLACERS. Whole of United Kingdom (including North Stafford).

Number of persons employed.

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture and Electrical Fittings.	Sanitary.	Total.	Totals. M. and F.
1904—M.	219	1,574	219	42	136	28	126	2,344	2,441
F.	—	40	16	—	—	38	3	97	
1907—M.	252	1,593	111	51	113	40	131	2,291	2,411
F.	3	52	30	—	—	32	3	120	

Number of cases of lead poisoning.

	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Total cases.	Attack rate per 1,000.	Total cases. M.& F.	Attack rate per 1,000.
Under Special Rules from 1894.																		
1899—M.	5	23	49	31	2	9	1	24	—	—	—	—	—	—	57	24	59	24
F.	—	—	2	50	—	—	—	—	—	—	—	—	—	—	2	21		
1900—M.	1	5	27	17	5	23	1	24	—	—	1	36	—	—	35	15	36	15
F.	—	—	—	—	—	—	—	—	—	—	1	26	—	—	1	10		
1901—M.	2	9	19	12	—	—	—	—	1	7	—	—	—	—	22	9	22	9
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1902—M.	1	5	14	9	1	5	—	—	—	—	—	—	1	8	17	7	18	7
F.	—	—	—	—	—	—	—	—	—	—	1	26	—	—	1	10		
1903—M.	—	—	8	5	1	5	1	24	—	—	—	—	—	—	10	4	11	5
F.	—	—	—	—	—	—	—	—	—	—	1	26	—	—	1	10		
Medical examination of men began.																		
1904—M.	—	—	13	8	—	—	—	—	—	—	—	—	—	—	13	6	14	6
F.	—	—	1	25	—	—	—	—	—	—	—	—	—	—	1	10		
1905—M.	2	9	6	4	—	—	—	—	—	—	—	—	—	—	8	3	8	3
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1906—M.	—	—	15	9	—	—	—	—	—	—	—	—	—	—	15	7	16	7
F.	—	—	1	19	—	—	—	—	—	—	—	—	—	—	1	8		
1907—M.	1	4	17	11	2	18	—	—	1	9	—	—	—	—	21	9	22	9
F.	—	—	—	—	1	33	—	—	—	—	—	—	—	—	1	8		
1908—M.	1	4	12	8	1	9	—	—	—	—	—	—	1	8	15	7	16	7
F.	—	—	—	—	—	—	—	—	—	—	1	31	—	—	1	8		
1909—M.	1	4	8	5	—	—	—	—	—	—	—	—	—	—	9	4	9	4
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		

SECTIONAL TABLE F.

MAJOLICA PAINTERS. Whole of United Kingdom (including North Stafford).

Number of persons employed.

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture and Electrical Fittings.	Sanitary.	Total.	Totals. M. and F.
1904—M.	—	7	17	4	1	—	1	30	587
F.	—	40	417	98	1	—	1	557	
1907—M.	—	6	16	4	—	—	2	28	486
F.	3	43	290	118	4	—	—	458	

Number of cases of lead poisoning.

	Cases.	Attack rate per 1,000.	Cases	Attack rate per 1,000.	Cases.	Attack rate per 1,000	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.	Total cases.	Attack rate per 1,000.	Total cases. M.& F.	Attack rate per 1,000.
Under Special Rules from 1894.																		
1899—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	25	43
F.	—	—	7	175	14	41	4	41	—	—	—	—	—	—	25	45		
1900—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	14
F.	—	—	1	25	6	14	1	10	—	—	—	—	—	—	8	14		
1901—M.	—	—	—	—	1	59	—	—	—	—	—	—	—	—	1	33	6	10
F.	—	—	—	—	4	10	1	10	—	—	—	—	—	—	5	9		
1902—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	5
F.	—	—	—	—	2	5	1	10	—	—	—	—	—	—	3	5		
1903—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	17
F.	—	—	—	—	6	14	4	41	—	—	—	—	—	—	10	18		
1904—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	12
F.	—	—	—	—	6	14	1	10	—	—	—	—	—	—	7	13		
1905—M.	—	—	—	—	1	59	—	—	—	—	—	—	—	—	1	33	8	14
F.	—	—	—	—	7	17	—	—	—	—	—	—	—	—	7	13		
1906—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	14
F.	—	—	—	—	6	21	—	—	—	—	1		—	—	7	15		
1907—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	8
F.	—	—	1	23	2	7	1	8	—	—	—	—	—	—	4	9		
1908—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	16
F.	—	—	2	47	5	17	1	8	—	—	—	—	—	—	8	17		
1909—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	8
F.	—	—	1	23	3	10	—	—	—	—	—	—	—	—	4	9		

SECTIONAL TABLE G.

GROUND LAYERS. Whole of United Kingdom (including North Stafford).

Number of persons employed.

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture and Electrical Fittings.	Sanitary.	Totals.	Totals. M. and F.
1904—M.	21	25	—	—	1	2	—	49	249
F.	73	112	—	—	13	2	—	200	
1907—M.	37	16	—	1	1	2	1	58	215
F.	71	76	—	2	5	3	—	157	

Number of cases of lead poisoning.

	China. Cases.	China. Attack rate per 1,000.	Earthenware. Cases.	Earthenware. Attack rate per 1,000.	Tiles. Cases.	Tiles. Attack rate per 1,000.	Majolica. Cases.	Majolica. Attack rate per 1,000.	Jet and Rockingham. Cases.	Jet and Rockingham. Attack rate per 1,000.	China Furniture and Electrical Fittings. Cases.	China Furniture and Electrical Fittings. Attack rate per 1,000.	Sanitary. Cases.	Sanitary. Attack rate per 1,000.	Total Cases.	Attack rate per 1,000.	Total Cases. M.& F.	Attack rate per 1,000.
Under Special Rules from 1894.																		
1899—M.	—	—	2	80	—	—	—	—	—	—	—	—	—	—	2	41	10	40
F.	—	—	8	71	—	—	—	—	—	—	—	—	—	—	8	40		
1900—M.	—	—	1	40	—	—	—	—	—	—	—	—	—	—	1	20	7	28
F.	2	27	4	36	—	—	—	—	—	—	—	—	—	—	6	30		
1901—M.	—	—	1	40	—	—	—	—	—	—	—	—	—	—	1	20	1	4
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1902—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	16
F.	—	—	4	36	—	—	—	—	—	—	—	—	—	—	4	20		
1903—M.	—	—	1	40	—	—	—	—	—	—	—	—	—	—	1	20	3	12
F.	—	—	2	18	—	—	—	—	—	—	—	—	—	—	2	10		
1904—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	8
F.	—	—	2	18	—	—	—	—	—	—	—	—	—	—	2	10		
1905—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1906—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	9
F.	—	—	2	26	—	—	—	—	—	—	—	—	—	—	2	13		
1907—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	5
F.	—	—	1	13	—	—	—	—	—	—	—	—	—	—	1	6		
1908—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1909—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		

SECTIONAL TABLE H.

COLOUR DUSTERS. Whole of United Kingdom (including North Stafford).

Number of persons employed.

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture and Electrical Fittings.	Sanitary.	Totals.	Totals. M. and F.
1904—M.	3	4	2	—	—	—	—	9	159
F.	95	52	3	—	—	—	—	150	
1907—M.	8	5	—	1	—	—	—	14	157
F.	93	45	—	1	4	—	—	143	

Number of cases of lead poisoning.

	China. Cases.	China. Attack rate per 1,000.	Earthenware. Cases.	Earthenware. Attack rate per 1,000.	Tiles. Cases.	Tiles. Attack rate per 1,000.	Majolica. Cases.	Majolica. Attack rate per 1,000.	Jet and Rockingham. Cases.	Jet and Rockingham. Attack rate per 1,000.	China Furniture and Electrical Fittings. Cases.	China Furniture and Electrical Fittings. Attack rate per 1,000.	Sanitary. Cases.	Sanitary. Attack rate per 1,000.	Total Cases.	Attack rate per 1,000.	Total Cases. M.& F.	Attack rate per 1,000.
Under Special Rules from 1908.																		
1899—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9	57
F.	4	42	5	96	—	—	—	—	—	—	—	—	—	—	9	60		
1900—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	31
F.	5	53	—	—	—	—	—	—	—	—	—	—	—	—	5	33		
1901—M.	1		—	—	—	—	—	—	—	—	—	—	—	—	1		3	19
F.	2	21	—	—	—	—	—	—	—	—	—	—	—	—	2	13		
1902—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	6
F.	—	—	1	19	—	—	—	—	—	—	—	—	—	—	1	7		
1903—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	6
F.	1	11	—	—	—	—	—	—	—	—	—	—	—	—	1	7		
1904—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1905—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	13
F.	1	11	1	19	—	—	—	—	—	—	—	—	—	—	2	13		
1906—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1907—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1908—M.	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	71	1	6
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1909—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		

SECTIONAL TABLE J.

COLOUR AND GLAZE BLOWERS. Whole of United Kingdom (including North Stafford).

Number of persons employed.

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture and Electrical Fittings.	Sanitary.	Total.	Totals. M. and F.
1904—M.	3	22	3	6	1	1	—	36	251
F.	22	181	2	—	10	—	—	215	
1907—M.	15	28	2	5	1	—	—	51	339
F.	48	221	3	12	4	—	—	288	

Number of cases of lead poisoning.

	China. Cases.	China. Attack rate per 1,000.	Earthenware. Cases.	Earthenware. Attack rate per 1,000.	Tiles. Cases.	Tiles. Attack rate per 1,000.	Majolica. Cases.	Majolica. Attack rate per 1,000.	Jet and Rockingham. Cases.	Jet and Rockingham. Attack rate per 1,000.	China Furniture. Cases.	China Furniture. Attack rate per 1,000.	Sanitary. Cases.	Sanitary. Attack rate per 1,000.	Total Cases.	Attack rate per 1,000.	Total Cases M.& F.	Attack rate per 1,000.
1899—M.	—	—	1	45	—	—	—	—	—	—	—	—	—	—	1	28	2	8
F.	—	—	1	6	—	—	—	—	—	—	—	—	—	—	1	5		
1900—M.	—	—	1	45	—	—	—	—	—	—	—	—	—	—	1	28	5	20
F.	—	—	4	22	—	—	—	—	—	—	—	—	—	—	4	19		
1901—M.	—	—	—	—	1		—	—	—	—	—	—	—	—	1	28	2	8
F.	—	—	1	6	—	—	—	—	—	—	—	—	—	—	1	5		
Colour blowing first included in schedule of dangerous processes.																		
1902—M.	—	—	—	—	1		—	—	—	—	—	—	—	—	1	28	2	8
F.	—	—	1	6	—	—	—	—	—	—	—	—	—	—	1	5		
1903—M.	—	—	—	—	1		—	—	1		—	—	—	—	2	56	4	16
F.	—	—	2	11	—	—	—	—	—	—	—	—	—	—	2	9		
1904—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	4
F.	—	—	1	6	—	—	—	—	—	—	—	—	—	—	1	5		
1905—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	8
F.	—	—	2	11	—	—	—	—	—	—	—	—	—	—	2	9		
1906—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	21
F.	1	21	6	27	—	—	—	—	—	—	—	—	—	—	7	24		
1907—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	21
F.	2	42	5	23	—	—	—	—	—	—	—	—	—	—	7	24		
1908—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	15
F.	—	—	5	23	—	—	—	—	—	—	—	—	—	—	5	17		
1909—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		

SECTIONAL TABLE K.

UNCLASSIFIED PERSONS in contact with Lead. Whole of United Kingdom (including North Stafford).

Number of persons employed.

	China.	Earthenware.	Tiles.	Majolica.	Jet and Rockingham.	China Furniture and Electrical Fittings.	Sanitary.	Total.	Totals. M. and F.
1904—M.	16	131	50	3	6	2	6	214	311
F.	8	73	8	—	1	—	7	97	
1907—M.	19	205	73	—	4	11	15	327	459
F.	12	89	5	5	10	7	4	132	

Number of cases of lead poisoning.

	China. Cases.	China. Attack rate per 1,000.	Earthenware. Cases.	Earthenware. Attack rate per 1,000.	Tiles. Cases.	Tiles. Attack rate per 1,000.	Majolica. Cases.	Majolica. Attack rate per 1,000.	Jet and Rockingham. Cases.	Jet and Rockingham. Attack rate per 1,000.	China Furniture. Cases.	China Furniture. Attack rate per 1,000.	Sanitary. Cases.	Sanitary. Attack rate per 1,000.	Total Cases.	Attack rate per 1,000.	Total Cases. M.& F.	Attack rate per 1,000.
1899—M.	—	—	5	38	—	—	—	—	—	—	—	—	—	—	5	23	10	32
F.	—	—	5	69	—	—	—	—	—	—	—	—	—	—	5	52		
1900—M.	—	—	2	15	1	20	—	—	—	—	—	—	—	—	3	14	11	35
F.	1		7	96	—	—	—	—	—	—	—	—	—	—	8	82		
1901—M.	—	—	1	8	—	—	—	—	—	—	—	—	—	—	1	5	3	10
F.	—	—	2	27	—	—	—	—	—	—	—	—	—	—	2	21		
Clause to cover these workers added.																		
1902—M.	—	—	1	8	—	—	—	—	—	—	—	—	—	—	1	5	2	6
F.	—	—	—	—	—	—	1		—	—	—	—	—	—	1	10		
1903—M.	—	—	1	8	—	—	—	—	—	—	—	—	—	—	1	5	5	16
F.	2		2	27	—	—	—	—	—	—	—	—	—	—	4	41		
Medical examination of men began.																		
1904—M.	—	—	2	15	—	—	—	—	—	—	—	—	—	—	2	9	4	13
F.	—	—	2	27	—	—	—	—	—	—	—	—	—	—	2	21		
1905—M	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	6
F.	—	—	2	27	—	—	—	—	—	—	—	—	—	—	2	21		
1906—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
1907—M.	—	—	4	20	—	—	—	—	—	—	—	—	—	—	4	12	5	11
F.	1	83	—	—	—	—	—	—	—	—	—	—	—	—	1	8		
1908—M.	—	—	3	15	—	—	—	—	1		—	—	—	—	4	12	5	11
F.	—	—	1	11	—	—	—	—	—	—	—	—	—	—	1	8		
1909—M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		

APPENDIX VIII.

Lead Poisoning Cases, 1896-1909, in factories under Earthenware and China Special Rules,

North Staffordshire District only,

Table compiled from Home Office records

Note.—The attack rates for the years 1896 to 1898 are calculated on the number of persons employed in 1898; the attack rates for 1899 to 1901 on the numbers employed in 1900; the attack rates for 1902 to 1905 on the numbers employed in 1904; and the attack rates for 1906 to 1909 on the numbers employed in 1907.

Introduction of the most notable changes of rules indicated in the body of the Tables.

GENERAL TABLE.

All LEAD WORKERS in places under Earthenware and China Rules.
North Staffordshire District only.

Number of persons employed.

		Number	Totals
1898	M.	3,123	4,703
	F.	1,580	
1900	M.	3,134	4,857
	F.	1,723	
1904	M.	3,250	5,131
	F.	1,881	
1907	M.	3,371	5,299
	F.	1,928	

Number of cases of lead poisoning.

		Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.
1896	M.	152	49	351	75
	F.	199	126		
1897	M.	174	56	386	82
	F.	212	134		
1898	M.	152	49	348	74
	F.	196	124		
1899	M.	110	35	204	42
	F.	94	55		
1900	M.	81	26	165	34
	F.	84	49		
1901	M.	42	13	84	17
	F.	42	24		
1902	M.	26	8	66	13
	F.	40	21		
1903	M.	30	9	75	15
	F.	45	24		
1904	M.	28	9	84	16
	F.	56	30		
1905	M.	31	10	75	15
	F.	44	23		
1906	M.	30	9	85	16
	F.	55	29		
1907	M.	40	12	82	15
	F.	42	22		
1908	M.	41	12	91	17
	F.	50	26		
1909	M.	23	7	49	9
	F.	26	13		

SECTIONAL TABLE A.

DIPPERS. North Staffordshire District only.

Number of persons employed.

			Totals.
1898	M.	495	576
	F.	81	
1900	M.	501	564
	F	63	
1904	M.	481	566
	F.	85	
1907	M.	504	611
	F.	107	

Number of cases of lead poisoning.

		Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.
1894 Rules: Overalls, ventilation, sweeping, lavatories, &c., introduced.					
1896	M.	53	107	68	118
	F.	15	185		
1897	M.	48	97	57	99
	F.	9	111		
1898	M.	41	83	48	83
	F.	7	86		
1898 Rules: Monthly medical examination of women and young persons began.					
1899	M.	30	60	37	66
	F.	7	111		
1900	M.	30	60	33	59
	F.	3	48		
1901	M.	12	24	13	23
	F.	1	16		
1901 Rules: Lord James' first award; little change.					
1902	M.	5	10	6	11
	F.	1	12		
1903	M.	10	21	11	19
	F.	1	12		
1903 Rules: Lord James' final award; medical examination of men began.					
1904	M.	15	31	19	34
	F.	4	47		
1905	M.	10	21	14	25
	F.	4	47		
1906	M.	16	32	21	34
	F.	5	47		
1907	M.	17	34	21	34
	F.	4	37		
1908	M.	11	22	16	26
	F.	5	47		
1909	M.	12	24	15	24
	F.	3	28		

SECTIONAL TABLE B.

DIPPERS' ASSISTANTS. North Staffordshire District only.

Number of persons employed.

			Totals.
1898	M.	518	625
	F.	107	
1900	M.	386	595
	F.	209	
1904	M.	334	573
	F.	239	
1907	M.	368	625
	F.	257	

Number of cases of lead poisoning.

		Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.
1894 Rules : Overalls, ventilation, sweeping, lavatories, &c., introduced.					
1896	M.	12	23	30	48
	F.	18	168		
1897	M.	29	56	39	62
	F.	10	93		
1898	M.	20	39	39	62
	F.	19	178		
1898 Rules : Monthly medical examination of women and young persons began.					
1899	M.	10	26	26	44
	F.	16	77		
1900	M.	8	21	23	39
	F.	15	72		
1901	M.	4	10	14	24
	F.	10	48		
1901 Rules : Lord James' first award; little change.					
1902	M.	3	9	12	21
	F.	9	38		
1903	M.	5	15	19	33
	F.	14	59		
1903 Rules : Lord James' final award; monthly medical examination of men began.					
1904	M.	—	—	16	28
	F.	16	67		
1905	M.	4	12	16	28
	F.	12	50		
1906	M.	4	11	19	30
	F.	15	58		
1907	M.	1	3	9	14
	F.	8	31		
1908	M.	6	16	19	30
	F.	13	51		
1909	M.	1	3	7	11
	F.	6	23		

SECTIONAL TABLE C.

WARE CLEANERS. North Staffordshire District only.

Number of persons employed.

			Totals.
1898	M.	105	563
	F.	458	
1900	M.	81	495
	F.	414	
1904	M.	88	483
	F.	395	
1907	M.	91	487
	F.	396	

Number of cases of lead poisoning.

		Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000
1894 Rules: Overalls, ventilation, sweeping, lavatories, &c., introduced.					
1896	M.	2	19	59	105
	F.	57	124		
1897	M.	—	—	68	121
	F.	68	148		
1898	M.	1	10	59	105
	F.	58	127		
1898 Rules: Monthly medical examination of women and young persons began; and exhaust fans or water troughs introduced as alternatives.					
1899	M.	3	37	32	65
	F.	29	70		
1900	M.	6	74	45	91
	F.	39	94		
1901	M.	1	12	23	46
	F.	22	53		
1901 Rules: Exhaust fans introduced in addition to water troughs.					
1902	M.	2	23	21	43
	F.	19	48		
1903	M.	2	23	15	31
	F.	13	33		
1903 Rules: Monthly medical examination of men began.					
1904	M.	—	—	26	54
	F.	26	66		
1905	M.	3	34	16	33
	F.	13	33		
1906	M.	—	—	18	37
	F.	18	45		
1907	M.	—	—	17	35
	F.	17	43		
1908	M.	2	22	20	41
	F.	18	45		
1909	M.	—	—	13	27
	F.	13	33		

SECTIONAL TABLE D.

GLOST PLACERS. North Staffordshire District only.

Number of persons employed.

			Totals.
1898	M.	1,805	1,851
	F.	46	
1900	M.	1,821	1,876
	F.	55	
1904	M.	1,872	1,933
	F.	61	
1907	M.	1,853	1,933
	F.	80	

Number of cases of lead poisoning.

		Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.
1894 Rules: Overalls, ventilation, sweeping, lavatories, &c., introduced.					
1896	M.	58	32	59	32
	F.	1	22		
1897	M.	53	29	55	30
	F.	2	43		
1898	M.	48	27	49	26
	F.	1	22		
1898 Rules: Medical examination of women and young persons began.					
1899	M.	53	29	54	29
	F.	1	18		
1900	M.	28	15	28	15
	F.	—	—		
1901	M.	19	10	19	10
	F.	—	—		
1901 Rules: Little change.					
1902	M.	12	6	13	7
	F.	1	16		
1903	M.	9	5	9	5
	F.	—	—		
1903 Rules: Medical examination of men began.					
1904	M.	8	4	8	4
	F.	—	—		
1905	M.	7	4	7	4
	F.	—	—		
1906	M.	8	4	8	4
	F.	—	—		
1907	M.	14	8	15	8
	F.	1	12		
1908	M.	13	7	14	8
	F.	1	12		
1909	M.	8	4	8	4
	F.	—	—		

SECTIONAL TABLE E.

MAJOLICA PAINTERS. North Staffordshire District only.

Number of persons employed.

			Totals
1898	M.	—	295
	F.	295	
1900	M.	—	425
	F.	425	
1904	M.	9	482
	F.	473	
1907	M.	7	394
	F.	387	

Number of cases of lead poisoning.

		Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.
1894 Rules: Overalls, ventilation, sweeping, lavatories, &c., introduced.					
1896	M.	—	—	39	132
	F.	39	132		
1897	M.	—	—	48	163
	F.	48	163		
1898	M.	—	—	31	105
	F.	31	105		
1898 Rules: Monthly medical examination introduced.					
1899	M.	—	—	20	47
	F.	20	47		
1900	M.	—	—	4	9
	F.	4	9		
1901	M.	—	—	3	7
	F.	3	7		
1901 Rules: Little change.					
1902	M.	—	—	3	6
	F.	3	6		
1903	M.	—	—	10	21
	F.	10	21		
1903 Rules: Little change.					
1904	M.	—	—	7	15
	F.	7	15		
1905	M.	—	—	7	15
	F.	7	15		
1906	M.	—	—	7	18
	F.	7	18		
1907	M.	—	—	3	8
	F.	3	8		
1908	M.	—	—	7	18
	F.	7	18		
1909	M.	—	—	4	10
	F.	4	11		

SECTIONAL TABLE F.

GROUND LAYERS. North Staffordshire District only.

Number of persons employed.

			Totals.
1898 - - - - - - - -	M.	89	471
	F.	382	
1900 - - - - - - - -	M.	48	335
	F.	287	
1904 - - - - - - - -	M.	41	237
	F.	196	
1907 - - - - - - - -	M.	50	195
	F.	145	

Number of cases of lead poisoning.

		Cases.	Attack rate per 1,000.	Cases.	Attack rate per 1,000.
1894 Rules : Overalls, ventilation, sweeping, lavatories, &c., introduced.					
1896 - - - - - - - -	M.	16	180	50	106
	F.	34	89		
1897 - - - - - - - -	M.	15	169	55	117
	F.	40	105		
1898 - - - - - - - -	M.	10	112	55	117
	F.	45	118		
1898 Rules : Fans introduced; monthly medical examination of women and young persons began.					
1899 - - - - - - - -	M.	2	42	10	30
	F.	8	28		
1900 - - - - - - - -	M.	1	21	7	21
	F.	6	21		
1901 - - - - - - - -	M.	1	21	1	3
	F.	—	—		
1901 Rules : Lord James's Code ; changes in detail only.					
1902 - - - - - - - -	M.	—	—	4	17
	F.	4	20		
1903 - - - - - - - -	M.	1	24	3	13
	F.	2	10		
1903 Rules : Medical examination of men began.					
1904 - - - - - - - -	M.	—	—	2	8
	F.	2	10		
1905 - - - - - - - -	M.	—	—	—	—
	F.	—	—		
1906 - - - - - - - -	M.	—	—	2	10
	F.	2	14		
1907 - - - - - - - -	M.	—	—	1	5
	F.	1	7		
1908 - - - - - - - -	M.	—	—	—	—
	F.	—	—		
1909 - - - - - - - -	M.	—	—	—	—
	F.	—	—		

APPENDIX IX.

LEAD POISONING CASES IN LITHOGRAPHIC TRANSFER WORKS.

Tables compiled from Home Office records.

	Males.	Females.		Totals.
Number employed (1907) - - - - -	132	125	......	257
Lead Cases, 1899 - - - - - - -	7	4	......	11
„ 1900 - - - - - - -	7	3	......	10
„ 1901 - - - - - - -	6	1	......	7
„ 1902 - - - - - - -	—	2	......	2
„ 1903 - - - - - - -	2	1	......	3
„ 1904 - - - - - - -	—	3	......	3
„ 1905 - - - - - - -	2	3	......	5
„ 1906 - - - - - - -	—	5	......	5
„ 1907 - - - - - - -	2	8	......	10
„ 1908 - - - - - - -	—	2	......	2
„ 1909 - - - - - - -	1	—	......	1

These works have been under Special Rules since 1898, and there has been no change of Code.

APPENDIX X.

FATAL CASES OF LEAD POISONING IN POTTERIES: WHOLE OF UNITED KINGDOM.

Tables compiled from Home Office Records.

TABLE A.—CLASSIFICATION ACCORDING TO SEX.

Year.	Actual Deaths.		Death Rate per 1,000 employed.	
	Males.	Females.	Males. No. employed (1907), 4,504.	Females. No. employed (1907), 2,361.
1899 - - - - - - - - -	10	7	2·22	2·97
1900 - - - - - - - - -	4	4	0·89	1·69
1901 - - - - - - - - -	4	1	0·89	0·42
1902 - - - - - - - - -	4	1	0·89	0·42
1903 - - - - - - - - -	3	—	0·67	—
1904 - - - - - - - - -	4	—	0·89	—
1905 - - - - - - - - -	3	—	0·67	—
1906 - - - - - - - - -	3	1	0·67	0·42
1907 - - - - - - - - -	6	3	1·33	1·27
1908 - - - - - - - - -	10	2	2·22	0·85
1909 - - - - - - - - -	4	1	0·89	0·42
Average - - - - - - -	5	2	1·11	0·85

TABLE B.—CLASSIFICATION ACCORDING TO PROCESS.

——	Dippers.	Dippers Assistants.	Ware Cleaners.	Glost Placers.	Majolica Painters.	Others.	Total.
1899 - - - - - - - -	5	3	1	1	4	3	17
1900 - - - - - - - -	2	—	1	2	1	2	8
1901 - - - - - - - -	3	—	—	1	—	1	5
1902 - - - - - - - -	1	—	1	3	—	—	5
1903 - - - - - - - -	3	1	—	—	—	—	4
1904 - - - - - - - -	4	—	—	—	—	—	4
1905 - - - - - - - -	3	—	—	—	—	—	3
1906 - - - - - - - -	1	—	—	2	1	—	4
1907 - - - - - - - -	3	—	—	3	3	—	9
1908 - - - - - - - -	7	—	1	3	—	1	12
1909 - - - - - - - -	1	—	1	3	—	—	5
Total, 1899–1909 - - - -	33	4	5	18	9	7	76
No. employed (1907) - - - -	936	860	576	2,411	486	1,596	6,865
1899–1908. Average annual death rate per 1,000 - - - - -	3·2	·4	·8	·7	1·7	·4	1·0

APPENDIX XI.

Jet and Rockingham.

In connection with the question of the mode of absorption of lead into the human system, attention was called to the small number of cases of plumbism in the Jet and Rockingham branch of the industry, notwithstanding the fact that glazes containing a large percentage of soluble lead are freely used. The following tables show:—

(A) Incidence of plumbism in Jet and Rockingham manufacture as compared with the whole Earthenware and China Industry:

(B) Summary of the results of analyses of four Jet and Rockingham glazes made at the Government Laboratory in October, 1908.

TABLE A.

Incidence of lead poisoning in Jet and Rockingham manufacture as compared with whole Earthenware and China Industry.

Table compiled from Home Office Records.

	No. of Lead Workers Employed.		Lead Cases in 6 years (1904–1909.)		Average Attack Rate per annum per 1,000.	
Jet and Rockingham - -	M. 171 F. 70	Total - 241	M. †2 F. *5	Total - 7	M. 1·9 F. 11·9	Total - 4·8
Other Branches - - - -	M. 4,333 F. 2,291	Total - 6,624	M. 256 F. 312	Total - 568	M. 9·8 F. 22·6	Total - 14·3
Whole trade - - - -	M. 4,504 F. 2,361	Total - 6,865	M. 258 F. 317	Total - 575	M. 9·6 F. 22·4	Total - 14·0

† 1 Glost-placer, and 1 "other person in contact with Lead." * Dippers' Assistants.

TABLE B.

Summary of Results of Analyses, by Dr. T. E. Thorpe, of Jet and Rockingham Glazes (October, 1908).

The percentages of lead, cobalt, and manganese contained, were as follows:

	Total lead monoxide.	Cobalt oxide Co_3O_4.	Manganese, calculated as manganese dioxide.	Percentage of soluble lead, calculated in the manner prescribed in the special rules of December, 1903.
Jet Glaze, No. 1 - - - - - - - - - - -	51·55%	2·11%	—	51·0%
„ „ No. 2 - - - - - - - - - - -	51·82%	2·12%	—	51·0%
Rockingham Glaze, No. 1 - - - - - - - -	39·76%	—	6·56%	38·8%
„ „ No. 2 - - - - - - - -	45·01%	—	5·71%	43·8%

APPENDIX XII.

Earthenware and China: Lead Poisoning Cases.

Attack rate among young persons as compared with attack rate among adults.

Table compiled from Home Office Records.

		Young Persons.						Adults.					
		No. of lead cases.	Total.	No. employed.	Total.	Attack rate per 1,000.	Total.	No of lead cases.	Total.	No. employed.	Total.	Attack rate per 1,000.	Total.
1899 -	M.	9	31			29	53	119	218			28	35
	F.	22				80		99				47	
1900 -	M.	9	21			29	36	86	179			21	28
	F.	12				44		93				45	
1901 -	M.	2	7			6	12	55	99			13	16
	F.	5				18		44				21	
1902 -	M.	1	3			3	5	39	84			9	13
	F.	2				7		45				22	
1903 -	M.	4	8			13	14	39	89			9	14
	F.	4		M.		15		50		M.		24	
1904 -	M.	1	11	315	590	3	19	38	95	4189	6,275	9	15
	F.	10		F.		36		57		F.		27	
1905 -	M.	2	7	275		6	12	34	77	2086		8	12
	F.	5				18		43				21	
1906 -	M.	1	8			3	14	46	99			11	16
	F.	7				25		53				25	
1907 -	M.	—	5			—	8	52	98			12	16
	F.	5				18		46				22	
1908 -	M.	5	11			16	19	51	106			12	17
	F.	6				22		55				26	
1909 -	M.	—	2			—	3	28	56			7	9
	F.	2				7		28				13	

APPENDIX XIII.

Analysis of Certifying Surgeons' Reports on cases of Lead Poisoning in Earthenware and China and in all other Lead Industries as regards (1) Severity, (2) Number of Attack, and (3) Main Symptoms, for the five years 1903—1907.

Table supplied by Dr. Legge, H.M. Medical Inspector of Factories.

	China and Earthenware.				All other Lead Industries.			
	Males.		Females.		Males.		Females.	
	Cases.	Per cent.	Cases.	Per cent.	Cases.	Per cent.	Cases.	Per cent.
Severe	42	19·3	35	12·5	620	26·9	49	24·0
Moderate	97	44·7	97	34·6	612	26·5	53	25·9
Slight	77	35·5	144	51·4	1,021	44·3	97	47·5
Not stated	1	0·5	4	1·4	52	2·3	5	2·5
Total	217	100	280	100	2,305	100	204	100
First attack	137	63·1	238	85·0	1,553	67·4	161	78·9
Second attack	40	18·4	28	10·0	344	14·9	19	9·3
Third attack	36	16·6	9	3·2	319	13·8	17	8·3
Not stated	4	1·8	5	1·8	89	3·9	7	3·4
Total	217	100	280	100	2,305	100	204	100
Gastric	137	63·1	225	80·4	1,888	81·9	171	83·8
Anæmic	42	19·3	111	39·6	719	31·2	80	39·2
Headache	38	17·5	104	37·1	220	9·5	43	21·1
Paretic	87	40·1	46	16·4	495	21·5	47	23·0
Tremor*	17	7·8	11	3·9	81	3·5	5	2·5
Encephalopathic	16	7·4	18	6·4	78	3·4	10	4·9
Rheumatic	24	11·1	29	10·4	228	9·9	13	6·4
Other	18	8·3	4	1·5	84	3·6	1	0·5
Not stated	2	0·9	1	0·4	70	3·0	5	2·5

APPENDIX XIV.

BELGIUM.

Ministry of Industry and Labour.
Labour Office.

Inspection of Factories.
(Medical Service).

Instructions for the Use of Approved Surgeons (médecins-agréés) by the Minister of Industry and Labour for periodical examination of workers exposed to lead.

The approved surgeons are free to refuse if their services are asked for outside their place of residence.

On their side occupiers obliged to comply with regulations for the periodical examination of their workers are allowed to choose their physician from amongst those approved.

In the course of their work the approved physicians must conform with the following conditions :—

I. *Professional secrecy is "de rigueur"* towards (1) the occupier, (2) the workman, (3) persons other than inspectors of factories. The approved physicians will refrain from every indication, verbal or written, of such character as to enable lay persons to know the real state of the health of the persons examined.

No remarks in the official register shall be made otherwise than by means of conventional signs.

Approved physicians desirous of making use, in a scientific publication, of their observations must obtain the permission beforehand of the Minister of Industry and Labour.

II. In chronic lead poisoning it is often very difficult to interpret exactly the pathological troubles observed. Hence the reason for the approved surgeon noting only, without comment, the symptoms. *They must not form a diagnosis* even in apparently the most straightforward cases.

Still more *they must abstain from demanding the removal of a sick workman,* this duty being left for medical inspectors charged with the control. When in the course of an examination the approved surgeon finds a subject whom he wishes to suspend, he shall notify the fact by letter to the Principal Medical Inspector attached to the Central Administration, with whom he can correspond free of charge.

III. In order to co-ordinate as far as possible the results, the following are the symptoms of lead poisoning most commonly observed, and the conventional signs to be made use of in referring to them.

(1) Blood and Circulatory System :—

Anæmia (A) is almost regularly present in lead poisoning. It depends on the one hand on *diminution in the proportion of hæmoglobin in the blood* (H $<$); and again on the other hand, on *diminution in the number of red blood cells* (GR $<$).

Examination of fresh blood often enables one to observe a *notable diminution in the ductility of the red blood cells* (DL $<$).

Certain authors note a *diminution in the number of*

white blood cells (GB $<$), but this is not admitted by everyone.

Blood preparations, fixed by means of absolute alcohol and stained by alkaline methylene blue, enable the presence of basophil granulations (Bas) in the red blood cells to be made out.

These same preparations allow also of detection of the presence of *nucleated blood cells* (GRN).

Finally, in preparations of dry blood the leucocytic formula can be studied, and the diminution of the polynuclear leucocytes (hypopolynucléose) (Pol $<$) be made out. This has been found to be very frequent in lead poisoning.

The *pulse* is often *slowed* (PR), *dicrotic* (PP), *irregular* (PI), and of *high tension* (P $>$). The sphygmographic tracing is often tremulous.

Arterio-sclerosis (AS), *pericarditis, myocarditis,* and *valvular lesions* (C) are at times symptoms of lead origin.

(2) Digestive Tract:—

Although the *Burtonian line* (L) does not constitute a sign of intoxication, properly so-called, it ought, however, to be noted every time it is seen, and the same with *tatoo plaques* (Ta) on the buccal mucous membrane; *ulcerative stomatitis* (U), *enlargement of the parotids or sub-maxillary glands* (Gl $>$).

Existence of *colic* (CLCO) during the previous period should be asked for at each examination, and it should be borne in mind that lead colic sometimes takes the form of constipation alternating with diarrhœa.

Marked enlargement of the liver (F $>$) is very frequent in lead poisoning.

Albuminuric nephritis (Alb) is often associated with plumbism.

(3) General nutrition:—

Certain cases of lead poisoning, and not the least grave, consist solely in a state of profound *cachexia* (AC) without other concomitant signs.

Joint pains, gout, and acute rheumatism (Art) are not rare in chronic poisoning by lead.

Glycosuria (Dia) is common enough, and often accompanied by *urobilin in the urine* (Ubil).

(4) Nervous system:—

Saturnine encephalopathy (En) varies from simple persistent headache to epileptic seizures of the most intense character and certain forms of mental derangement.

It can also take on the character of a sub-acute encephalitis, and cause death within 48 hours without prodromal symptoms.

Muscular weakness and lead paralysis (P) are classical, especially in the extensor muscles of the forearm. But care should be taken to verify the function of the motor muscles of the eye. There is, however, a *lead* aphonia (Aph) of paralytic origin.

The *reflexes* are sometimes *abolished* (R φ). Amongst them, the pharyngeal reflex is interesting. It is very much more frequently abolished than in normal individuals.

Anæsthetic patches (An) are met with, most often on the back of the hand, forearm (on the extensor surfaces) and on the calf of the leg.

(5) Organs of sense:—

The smell is often *diminished* (O $<$) or *abolished* (O φ).

Troubles of vision (V) are frequent, depending sometimes on the alteration of the nerve centres, and sometimes on the disorders of the retina of albuminuric origin.

IV. It is to be understood that it is unnecessary in each subject examined, and at each successive examination, to inquire into all the symptoms described above. At the same time at the first examination of a person who has been working a long time in lead, the approved physicians are advised to carry their investigation as as far as possible.

The proportion of hæmoglobin, notably by the colorimetric method of Tallqvist, which is very simple and rapid, is particularly desirable. The Department of Medical Inspection regards 80 per cent. and over as a normal proportion of hæmoglobin (H+), and as too low a proportion (H $<$) anything below 80 per cent., judged by the Tallqvist method.

The Medical Inspectorial Staff is at the disposal of the approved surgeons to assist their inquiries or to make with them microscopical examinations of the blood, and determine the percentage of hæmoglobin by Fleischl's apparatus, which necessitates a special apparatus and a fair amount of practice in this sort of work.

Similarly too with ophthalmoscopic examinations, examination of the nervous system, and particularly for measuring the comparative strength of the extensor and flexor muscles. For these purposes the Staff of Medical Inspectors possess special registering apparatus.

The minimum inquiry demanded at each examination and for each subject is given on the card, which shows at the same time the conventional signs to be employed and the order to be followed in the declaration.

When the approved surgeon cannot find any symptom of lead, it will suffice to append his initials opposite the case in the register.

Examination of Persons exposed to Lead.

Signs to be adopted for indication of symptoms in the course of each examination:—

Anæmia (A).
Pulse (P)
Arterio-sclerosis (AS)
Blue line (L)
Colic (CL).
Constipation (CO).
Diarrhœa (D).
Headache—Vertigo—Encephalopathy (Eu).
Weakness or paralysis of the extensors of the hands (Pie).
Tremor (T).
Reflexes (R).

The sign + indicates the normal state.
,, $<$,, a diminution.
,, $>$,, an increase.
,, φ ,, the abolition.

Signs to be adopted for indication of other symptoms of lead poisoning:—

Hæmoglobin (H).
Red blood cells (GR)
White blood cells (GB).
Ductility of red blood cells (DL).
Basophil granulations of red blood cells (Bas).
Nucleated blood cells (GRN).
Polynucleosis (Pol).
Slow pulse (PR).
Polycrotic pulse (PP).
Irregular pulse (PI).
High tension pulse (P).
Pericarditis—Myocarditis—Valvular lesions (C).
Tatooed patches (Ta).
Ulcerative stomatitis (U).
Enlargement of the parotid or sub-maxillary glands (Gl).
Alternations of diarrhœa and constipation (CO/D).
Liver (F).
Albuminuric nephritis (Alb).
Cachexia (AC).
Arthralgia, gout, acute rheumatism (Art).
Glycosuria (Dia).
Urobilinuria (Ubil).
Aphonia (Aph).
Inco-ordination (I).
Anæsthetic patches (An).
Smell (O).
Vision (V).

APPENDIX XV.

Particulars regarding Age and Health of Lead-workers, supplied by Dr. J. F. Arlidge, Certifying Surgeon for Stoke-on-Trent, Fenton and Longton.

Explanatory Note.—The Certifying Surgeons of the four North Staffordshire pottery districts were requested by letter sent on the 6th July, 1908, to note how many of the persons then subject to monthly examination were showing definite signs of lead impregnation, although not yet in such a condition as to necessitate suspension; they were also asked as far as possible to classify the persons so noted into the usual decennial age periods. The tables printed in this and the following three Appendices are based on the observations made by the Certifying Surgeons in pursuance of this request.

TABLE A.—Males.

	Age 15 to 25	25 to 35	35 to 45	45 to 55	55 to 65	Over 65		
Total examined -	341	328	255	111	20	3	= 1,058	
Total not satisfactory	20	21	42	20	6	1	= 110	= about $10\frac{1}{2}$ p.c. unsatisfactory.

Table showing condition—or disease—or symptoms rendering the worker in an unsatisfactory state to work in Lead.

Age.	Epilepsy.	Rheumatism.	Neglect.	Drink.	Anæmia or Pallor.	Blue Line.	Weak Wrists.	Stomach Giddiness.	Previous Attack.	Gout.	Tremor*	Total.
15 to 25 -	—	2	4	—	1	6	6	—	1	—	—	= 20
25 to 35 -	—	1	2	4	1	6	3	—	3	—	1	= 21
35 to 45 -	—	5	3	6	2	5	7	1	10	1	2	= 42
45 to 55 -	2	5	—	1	1	2	2	—	7	—	—	= 20
55 to 65 -	—	2	—	—	1	—	—	—	2	1	—	= 6
Over 65 -	—	—	—	—	—	—	—	1	—	—	—	= 1
Total -	2	15	9	11	6	19	18	2	23	2	3	= 110

* The column Tremor indicates men suffering from Tremor, but not sufficient evidence as to whether caused by drink, excessive smoking, or some other cause not quite clear.

TABLE B.—Females.

	Age 15 to 25	25 to 35	35 to 45	45 to 55	55 to 65	Over 65		
Total examined -	269	128	142	41	17	4	= 601	
Total unsatisfactory	15	12	8	8	2	1	= 46	= about $7\frac{1}{2}$ per cent.

Table showing condition—or disease—or symptoms rendering the worker in an unsatisfactory state to work in Lead.

Age.	Epilepsy.	Rheumatism.	Anæmia.	Neglect.	Weakness of Wrist.	Blue Line.	Stomach Troubles.	Previous Attack.	Total
15 to 25 -	—	4	5	1	2	2	—	1	= 15
25 to 35 -	1	1	3	—	1	2	—	4	= 12
35 to 45 -	—	—	1	1	—	3	—	3	= 8
45 to 55 -	1	1	—	1	—	3	—	2	= 8
55 to 65 -	—	1	—	—	—	—	1	—	= 2
Over 65 -	—	—	—	—	—	1	—	—	= 1
Total -	2	7	9	3	3	11	1	10	= 46

NOTES ON ABOVE TABLES.

Table A.—Males.

Taking the males first, and commencing at the age of 15 up to 25, it will be noticed that the largest number classed as unsatisfactory are put down as showing blue line, weak wrists, or neglect. The latter would cause one at once to look for a blue line, and weak wrists following shortly, or even one might expect to find constipation or even colic. The difficulty in the case of boys or young men is to get them to own up to any form of suffering or ill-health. In passing, I may add that in all ages this form of misleading the certifying surgeon is very much too prevalent, carried in some cases to the extent of telling deliberate untruths. This is to be regretted, and when found out and clearly proved some form of *correction* should follow, such as a week or more of suspension without compensation. It is naturally the duty, and should be the desire, of the certifying surgeon not only to watch for symptoms of lead trouble, but also (if the worker is suffering from any suspicious form of illness) to impress upon him the necessity of going to his own doctor for advice; in fact the worker should help the certifying surgeon and not wilfully, at all events, thwart him.

Among the men up to 35 years of age, six are noted as having blue line, and this probably means neglect in some way, and four will be noted as under column headed "Drink." This latter leads to neglect, not only in the man himself; for, if the wages are spent in drink frequently, it means a neglected home with suffering for those dependent on him. No alcohol should be taken during the hours of work, though I have no objection to the supper beer or stout, provided that the worker has properly washed his mouth out and brushed his teeth and thoroughly washed and cleansed himself. The six cases of blue line in this column—the four under the heading "Drink" and the two under the heading "Neglect"—show that neglect, drink, and want of cleanliness are factors which should be dealt with.

In the next age period, between 35 and 45, we find the largest number of unsatisfactory men. The number of cases of weakened wrists, rheumatism, drink, blue line, are more numerous than one would like. The reason of so many cases of rheumatism is not clear to me, and the large number under column "Previous Attacks" may mean that in their early days of lead work they had colic or some stomach trouble, but no lasting or very marked symptoms, such as wrist-drop, and that improvement took place and they were able to return to work; whether they should have done so is another question, for I have seen men with weakened wrists, colic, etc., return to work and not again suffer; on the other hand, I have seen men attacked suddenly with wrist-drop showing no other

symptoms, and without any warning, and such cases (coming on suddenly) must be looked upon with gravity, for improvement is very slow and recovery doubtful. But cases coming on slowly, that is, showing a gradual weakening, with or without other symptoms, I have seen quite recover their wrist power. But in all persons having suffered from the effects of lead there is a danger of recurrence.

There is nothing special to notice in those between 45 and 55, except the number of rheumatic cases and those under column headed "Previous Attacks." The reason for specially noting rheumatic cases is the number that complain of it—some slight cases, some severe cases—and the question as to whether it is advisable for a rheumatic subject to work in lead. In my opinion it is distinctly dangerous for gouty subjects to work in lead. I only know of two or three such cases who have recurrent attacks of gout but show no definite symptoms of lead.

I have no remarks to offer on those from 55 upwards. It will be noticed that two had rheumatism, one had gout, and two had a previous attack; barring the case of gout, I may say they are all samples of how some will work in lead all their lives and never seem to suffer from their occupation.

To sum up:—

EPILEPSY.—In my opinion, epileptics should not work in lead.

RHEUMATISM.—So many complain of rheumatism—further investigation is necessary in the district.

NEGLECT.—Should be visited by temporary suspension without compensation.

DRINK.—Should be visited by temporary suspension, without compensation.

PALLOR, ANÆMIA.—Should be carefully watched and suspension should follow if it increases, and the true cause should be ascertained where possible. All cases of anæmia in lead-workers should not be classed as lead.

BLUE LINE.—Should be noted, and other symptoms carefully watched for.

WEAK WRISTS.—In the young workers should mean suspension, if there is no evidence of weakness previous to employment. In older workers increase of loss of power should mean suspension.

STOMACH TROUBLE.—To be carefully watched, and worker advised to consult his doctor.

PREVIOUS ATTACK.—Much depends on the nature of the attack, the class of employment, and the habits of the worker.

GOUT.—Sufferers from recurrent attacks should be suspended, as continued work in lead is dangerous.

TREMOR.—If from excessive drinking or smoking, the worker should be cautioned; or, if he continues such habits, he should be suspended without compensation.

Table B.—Females.

In the females I note only three cases of neglect in all, though I am afraid some more might be classed in this list; therefore one is surprised to find that there are eleven cases of blue line, but most of them are in women over 35. This seems to show that when they started their work in lead they did not learn in their younger days the necessity of constantly cleansing their mouth and brushing their teeth before taking food. It is questionable if they are as careful as they should be now. The number of "Previous Attacks"—ten—generally means they had constipation, colic, miscarriages, or stomach and head troubles, and though they are now again at work they show no sign of further suffering from lead. Anæmia, as one finds in other trades is more or less prevalent, is in my opinion not necessarily due to lead. It is difficult to account for the seven cases under heading "Rheumatism." On referring to notes of some ten years ago I have been able to call to mind the condition of some of those who are still working and the manner they suffered at that time. Out of that number, 48 men and 60 women, I find some eleven are still at work and are noted in column "Previous Attacks."

APPENDIX XVI.

Particulars regarding Age and Health of Lead Workers, supplied by Dr. A. A. Hill, Certifying Surgeon, Tunstall.

See explanatory note to Appendix XV.

Cases of Poisoning occurring in three tile factories in Tunstall district.

1904	Males	4	7
	Females	3	
1905	Males	1	8
	Females	7	
1906	Males	1	5
	Females	4	
1907	Males	2	7
	Females	5	
Total			27

Classification of the above Cases, according to Occupation.

Majolica paintresses	12
Dippers and tile cleaners	7
Lead-house men and colour mixers	8
Total	27

Average Number Examined Monthly in Tunstall district.

1900	168	1904	575*
1901	172	1905	626
1902	161	1906	663
1903	209	1907	681

* Examination of men introduced at this date.

Persons at present occupied in Lead Processes who, although not in a condition definite enough to require suspension, exhibit symptoms that might indicate past impregnation with lead.

Ages	15 to 25.		25 to 35.		35 to 45.		45 to 55.		55 to 65.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
	0	0	1	0	3	1	4	1	2	0

APPENDIX XVII.

Particulars regarding Lead Workers examined by Dr. S. King Alcock, Certifying Surgeon for Burslem.
See explanatory note to Appendix XV.

Table showing number of workers with a blue line on the gums.

Class of Workers.	Number examined.		Number with blue line on gums.	
	Males.	Females.	Males.	Females.
Dippers and dipper's assistants	40	66	13	18
Ware cleaners	—	51	—	20
Glost placers	214	—	44	—
Majolica workers	—	51	—	12
Ground layers	—	2	—	1
Colour dusters	—	5	—	—
Colour blowers	15	17	2	4
Others	56	32	8	4
Total	325	224	67	59

Dr. Alcock took the occurrence of a blue line on the gums as some indication of the relative degree to which lead impregnation is observable in the different classes of lead workers as set forth above; but he thinks it impossible to deduce from this any practical conclusion regarding their state of health. (See evidence of Dr. S. King Alcock, Question 1811).

APPENDIX XVIII.

Particulars regarding Age and Health of Lead Workers, supplied by Dr. H. H. Folker, Certifying Surgeon for Hanley.

(See explanatory note to Appendix XV.)

Classification of all Lead Workers examined.

TABLE A.

	Number of Persons examined.				Number showing symptoms of ill-health.			
	Adult Males.	Males under 18.	Females.	Total.	Adult Males.	Males under 18.	Females.	Total.
Glaze and colour makers	83	—	—	83	—	—	—	—
Dippers	165	—	—	165	6	—	—	6
Dippers' Assistants	—	67	92	159	—	3	5	8
Ware cleaners	—	—	109	109	—	—	17	17
Glost placers	430	36	25	491	13	4	—	17
Majolica painters	—	—	46	46	—	—	10	10
Ground layers	9	—	28	37	1	—	2	3
Colour dusters	—	14	74	88	—	1	—	1
Colour and Glaze blowers	3	—	69	72	—	—	—	—
Others	—	—	26	26	—	—	—	—
Total	690	117	469	1,276	20	8	34	62

The number of married women working in lead processes is 153.

TABLE B.

Further Classification of those showing symptoms of ill-health, according to age, periods, etc.

Ages.	Males.				Females.				Total males & females.
	Blue line on gums.	Anæmia.	Other causes.	Total.	Blue line on gums.	Anæmia.	Other causes.	Total.	
15 to 25	1 dipper, 1 glost placer, 1 colour duster.	1 dipper, 1 dippers' assistant, 3 glost placers.	—	8	—	3 dippers' assistants, 1 ware cleaner.	—	4	12
25 to 35	4 glost placers.	2 dippers, 2 glost placers.	1 dipper, 1 glost placer.	10	2 dippers' assistants, 3 ware cleaners, 2 majolica paintresses.	4 ware cleaners.	—	11	21
35 to 45	2 dippers, 4 glost placers, 1 ground layer.	—	2 glost placers.	9	4 ware cleaners, 3 majolica paintresses.	1 majolica paintress, 1 ground layer.	1 majolica paintress.	10	19
45 to 55	—	—	—	—	1 ware cleaner, 3 majolica paintresses, 1 ground layer.	4 ware cleaners.	—	9	9
55 to 65	1 dipper.	—	—	—	—	—	—	—	1
Over 65	—	—	—	—	—	—	—	—	—
All ages	15	9	4	28	19	14	1	34	62

APPENDIX XIX.

PARTICULARS OF INSPECTION in North Staffordshire district.

TABLES supplied by J. A. REDGRAVE, Esq., I.S.O., H.M. Superintending Inspector of Factories for the Midland Division.

TABLE A.

Year.	Earthenware and China Works visited.				Total Factories on Register.
	4 times or more.	3 times.	Twice.	Once.	
1904	327	14	4	3	348
1905	245	65	17	7	334
1906	301	21	6	7	335
1907	288	31	5	8	332
Jan.-Oct. 1908	141	94	78	19	332

TABLE B.

Year.	Lithographic Transfer Works visited.				Total Factories on Register.
	4 times or more.	3 times.	Twice.	Once.	
1904	2	3	1	—	6
1905	5	—	—	—	5
1906	3	2	—	—	5
1907	4	—	—	1	5
Jan.-Oct. 1908	2	1	1	1	5

APPENDIX XX.

PROSECUTIONS IN NORTH STAFFORDSHIRE UNDER EARTHENWARE AND CHINA SPECIAL RULES.

(See Annual Reports of H.M. Chief Inspector of Factories.)

The first Rules were passed in 1894, and large batches of operatives were prosecuted at first, thus:—

	Employers prosecuted.	Workers prosecuted.
In 1895	1	41
„ 1896	5	21

Since that date the prosecutions have been as follows:—

	Employers prosecuted.	Workers prosecuted.
In 1897	1	3
„ 1898	1	7
„ 1899	14	1
„ 1900	11	0
„ 1901	5	3
„ 1902	4	6
„ 1903	14	8
„ 1904	5	3
„ 1905	5	6
„ 1906	5	4
„ 1907	1	0
„ 1908	9	0
Total of 12 years, 1897-1908	75	41
Average number of cases per annum	6·25	3·4

APPENDIX XXI.

PARTICULARS OF IRREGULARITIES noted in connection with Earthenware and China Special Rules and Notices sent to Occupiers (North Staffordshire District).

Compiled by H.M. Inspector of Factories at Stoke-on-Trent, from records in his office.

Details of irregularities noted at visits to potteries.	1905.	1906.	1907.	Half of 1908.
A. No. of entries in District Register showing irregularities of Special Rules noted. (Including entries resulting from visits by Lady Inspectors)	231	257	341	247
B. Total number of items of irregularity noted in reports of District Staff and Lady Inspectors	417	416	400	377
C. Total number of items of irregularity noted in reports of District Staff	221	230	285	334
D. Items of irregularity noted by District Staff and covered by written notices sent to Occupiers :—				
(a) Irregular examination of lead workers	4	4	4	1
(b) Failure to have entries made in Health Register	2	1	1	—
(c) „ provide overalls and head coverings	6	6	5	29
(d) „ „ accommodation for overalls, etc.	6	7	7	84
(e) „ „ satisfactory mess room	2	—	1	30
(f) Inefficiency of exhaust ventilation	7	15	35	96
(g) Failure to provide suitable washing accommodation	18	28	56	24
(h) Cleansing potters' shops	6	5	17	12
(i) „ dipping house	4	—	5	2
(j) „ „ „ boards	2	1	8	1
(k) Failure to affix notices	1	8	4	10
(l) Unsatisfactory arrangements for flat knocking	—	3	6	5
(m) „ „ „ moist ware cleaning	—	1	—	1
(n) „ „ „ thimble picking	—	—	—	2
(o) „ ventilation of potters' stoves	—	—	—	5
(p) Miscellaneous—not classified above	18	29	20	12
Total number of items covered by written notices to occupiers sent by District Staff	76	108	169	314

APPENDIX XXII.

INSTRUCTIONS drawn up by the Joint Committee of Pottery Manufacturers' Associations with regard to the process of Fritting. (February, 1900.)

The fritting, that is the turning into a glass-like substance, of the various raw materials of a glaze, may be accomplished in several ways :—

A In saggers,

B In crucibles,

CD In a frit-kiln.

The proper quantities of the raw materials having been weighed out, all lumps should be broken as small as possible, either

by hand,
by a spade, or
by a crushing mill.

It is useful to have two sheets of zinc fastened well together at one edge, to put on the floor, and on this zinc square put the materials as weighed, and mix on it.

After the lumps are broken, the mixing may be done

by turning over with a shovel,
by passing through a sieve, the finer the better, or
by putting through an enclosed mixer.

The better the materials are mixed, the more uniform will be the frit.

A *If saggers be used,* new and sound ones should be selected. Fill them up to the brim with clean slop flint, and when coated apparently $\frac{1}{4}$ in. thick, pour out the slop and allow the flint to dry slowly; when quite dry rub the cracks, which will now have appeared in the lining, full again with dry fine clean flint.

Fill the saggers not less than $\frac{2}{3}$ or more than $\frac{3}{4}$ full and level.

The saggers, when filled, may be fired in the fore-bung of the glost-kiln or oven.

B *If crucibles be used,* flint and fill as above described and fire as the saggers, or in a crucible frit-kiln.

The saggers and crucibles when withdrawn from the glost-oven, on opening at the usual time, can be broken away from the glass (or run-down frit) with a hammer. The more carefully the saggers and crucibles have been flinted, the more easily will the separation of the glass from the clay be done.

C *If a crucible frit-kiln be used,* the crucibles may be put into the cold kiln, fired up and allowed to cool, the glass being got out as described above, or

The crucibles may be withdrawn by means of a grip from the kiln while hot, and either thrown bodily into water, or their contents, if of such a softness as to permit it, may be poured into clean water.

The pouring may be done
by tilting the crucible while held in the grip, or
by turning the crucible over and out of the grip, mouth downwards, on to the double bar placed across the vessel containing the water. Thus two or more crucibles may be emptying themselves, while others are being withdrawn and re-filled.

Throwing the crucibles bodily into water breaks up the glass into larger pieces.

Pouring into water breaks up the glass into pieces about the size of coarse sand.

When the method of pouring from crucibles is adopted it is better not to flint the insides.

If the clay of the crucibles be good and the kiln be allowed to cool a little, the crucibles may be filled again while hot and returned to the kiln for a second time. The better the clay is and the more care used in putting them back into the kiln, the more often this pouring may be repeated with one set of crucibles.

If a second set be needed, the crucibles should be heated as hot as possible before being introduced within the kiln, which should be allowed to "go back" to such a heat that the crucibles will not crack when put in.

Keep the door through which the crucibles are put into and withdrawn from the kiln, shut while firing, and open as little as possible.

D *If a frit-kiln be used* the frit should be put in through the hole in the top to the amount that will produce the charge which the kiln has been built to contain when fluid.

The charging-hole should be covered, and the stopper of the pouring-hole flinted thickly and put in as soon as the first charge is in.

The kiln may be cold when the first charge is put in, or

The kiln may be red-hot.

If the latter, the stopper of the pouring-hole will have been flinted and put in at the commencement of the firing: it should be withdrawn and examined when the first charge is put in to see if it need re-flinting.

When thoroughly fritted, withdraw the stopper from the pouring-hole, and if needed punch out with a bar carefully the glass that may have become solid next the stopper. The frit will then run cut, helped if necessary by means of a scraper, and can be caught in clean water, by which it will be broken up into coarse sand.

As soon as the charge has all but completely run out, flint again thickly the pouring-hole stopper and adjust it, then re-charge the kiln with raw glaze.

The last running out before changing to another glaze, or the last charge of a fritting, should be more completely run out than other charges.

The vessel that contains the water into which the frit is run should be so deep and so large, and provided with such a supply of water (to be kept running in during the pouring out of the frit, and during the cooling of it) as to prevent it from being boiled too briskly, or from being thrown out of the vessel.

C To ascertain when the fritting is thoroughly accomplished, when using crucibles in a frit-kiln, withdraw one, so that a hook may be put in and some of the glass obtained. When cool, this glass should appear clear or free from raw (white) specks.

D When using a frit-kiln, remove the cover from the charging hole, and if all the raw mixture has disappeared, it may be concluded the frit is done; to make sure, insert a hook through the charging hole, and examine as above.

It is presumed that the manufacturer understands that the firing of a crucible frit-kiln, and a frit-kiln is similar to the "following" of a glost-oven or an enamel kiln.

Drawings of
- Crucible Frit-kiln
- Frit-kiln
- Crucible grip
- Double-bar, for supporting crucibles while pouring
- Hook
- Scraper
- Punching bar
- Stopper of pouring-hole
- Crucible
- Pouring-hole

can be obtained from A. P. Llewellyn, Esq., Tunstall, Staffordshire, on payment of £1 1s. 0d.

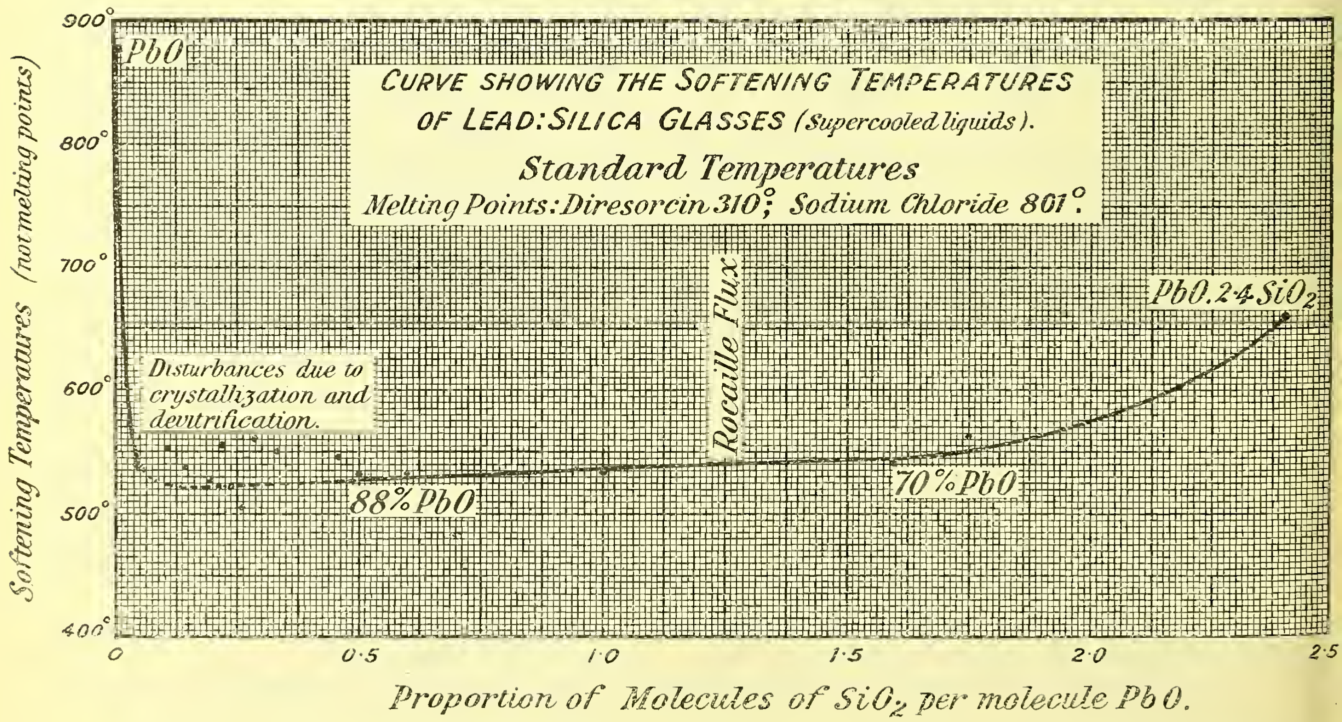
APPENDIX XXIII.

PARTICULARS OF THE RELATIVE FUSIBILITY OF LEAD SILICATES,

By Dr. J. W. Mellor.

A full account of experimental work on the softening temperatures of lead silicates, carried out by Dr. J. W. Mellor with the assistance of Mr. A. Latimer and Mr. A. D. Holdcroft, will be found in the Transactions of the English Ceramic Society, 1910, Vol. ix. page 126.

The principal results are shown graphically in the chart printed below, which has been forwarded by Dr. Mellor for inclusion in the Appendices to this Report.



At the end of the paper in the Transactions of the English Ceramic Society, above referred to, will be found also a note by Dr. J. W. Mellor on the nomenclature of lead silicates.

APPENDIX XXIV.

EXTRACTS from a Treatise on Lead Poisoning, by KENNETH W. GOADBY, Esq., M.R.C.S., D.P.H., etc.

EXPLANATORY NOTE.

At the request of the Committee, Mr. Kenneth W. Goadby has consented to the separate printing of a number of extracts from a treatise on "The Causes and Prevention of Lead Poisoning in Factories in which White Lead and other Compounds of Lead are Used or Manufactured." This treatise has not yet been published, but was originally submitted as a Prize Essay to the International Labour Bureau, Berne.

In summarising the essay those sections which deal with special processes have been omitted, only the more general conclusions, and those closely related to points upon which the Committee were inquiring, being included in the extracts.

INTRODUCTION.

In the present essay some attempt has been made to sketch out the causes of lead poisoning at present existing in factories in which compounds of lead, such as white lead, red lead, or other bodies of which lead forms a constituent, are manufactured into colours; the process of de-silverising is also briefly touched upon, owing to the intimate relation it bears to those manufactures in which lead and compounds of lead are made use of or produced.

The general plan that has been adopted is to give an account of the manufacture as carried on in various factories, indicating in passing the main sources of cases of poisoning. A further section then deals with each of these more dangerous portions of the process in detail, and the methods of poisoning and the precautions to be adopted relative to prevention are also discussed.

Some space is also devoted to the consideration of the statistical evidence of lead poisoning in English factories generally, and of two factories which the writer is well acquainted with in particular, and an attempt is made to pick out the most important and serious failings in the processes as carried on. Suggestions for improvement or amelioration are also given.

A further chapter is devoted to the more particularly medical aspect—the symptoms, diagnosis, and treatment of lead poisoning—with various practical suggestions for the benefit of those engaged in protecting the health of lead workers.

Some animal experiments made with lead dust are also described, and conclusions and deductions suggested from their consideration.

A *résumé* of the regulations in force for the prevention of lead poisoning is also given, together with a general *résumé* of the ground covered by the present paper.

An appendix is also attached in which the regulations in force in England and in Germany are given as issued by the respective authorities, and also the regulations which have been recently suggested for inclusion in future legislation regarding paint works in England.

Some illustrations from various sources are also given, and finally a draft of suggested rules or modifications of existing rules, together with an outline of a short pamphlet in simple language, which might with advantage be distributed to workers employed in white lead factories. The evidence of poisoning in its medical aspect and the statistics for the factories described, as well as the general *résumé* of the various processes considered in the course of the paper, are derived from the writer's own experience in the various lead factories.

CHAPTER II.

This chapter relates chiefly to dangers arising in the processes of making and packing white lead and litharge. But many passages are of more general application, and these are extracted in the order in which they occur.

"Not a little disagreement exists amongst various authorities upon the chief or main channel through which lead enters the system of the worker. Two main channels of infection are open: (*a*) the alimentary canal, (*b*) the respiratory system, whilst a less important one is the skin itself.

"The chemical composition of the lead compound causing plumbism is also of considerable moment, and finally its state of division."

"In either case a strong exhaust fan is connected with the top of the hopper, or into a hood over the barrel which is being filled, in such a manner that the white lead dust invariably produced in large quantities in the handling of this dry white lead is carried away from the worker into the air-ducts, and so into water. The men during this process wear respirators of some variety, the commonest form being a species of small linen nose-bag, covering the mouth and chin; and this, although preventing a good deal of inhalation of white lead dust, is a source of considerable discomfort to the worker, not only from its impeding his respiration in a mechanical way, but actually causing a considerable rise in the partial pressure of carbonic acid in the alveoli of the lungs, thus diminishing the rate of exchange of CO_2 and tending to increase the rate of respiration and the chances of inhaling white lead dust. It is not uncommon to find some degree of cyanosis in men who have been working for a considerable time at the very heavy work that the emptying of Dutch stoves entails when they have been wearing one of these linen bags.

"In any case the important point of any mill is that at the moment of adding the powdered compound of lead to the oil, and until such lead and oil be thoroughly incorporated together, the whole mill should be capable of being enclosed in a dust-proof covering. The exhaust dust-laden air either passes directly into water or through a series of fine sprays of water mixed with steam, the latter being the more efficacious. Filling the hopper of the paint-mill should also be conducted in a dust-proof and exhaust-connected chamber. If this were done at all paint mills, little or no poisoning would occur. The cheapest and most satisfactory way of enclosing these mills is by a combined covering of match-boarding and oil-canvas, doors with india-rubber edgings being used wherever entrance points are required. It is impossible to lay down any definite type of dust-preventment, as the mills differ so much in construction, but if care be taken that the whole of the mixing chamber and the hopper be enclosed at the moment the lead is in motion, a great proportion of the measures necessary to prevent poisoning by means of white lead in paint mills, will have been effected."

"In factory B, which came under my personal supervision in July, 1905, the cases of poisoning have occurred invariably in those places and amongst those workers subjected to considerable risks of inhalation of lead dust, and in another lead factory A, in which white lead and lead pipe and sheet are manufactured, and which came under my personal supervision in 1903, no case at all of plumbism, and very few cases of anæmia of any degree whatsoever, have occurred since 1902, in either the sheet-lead, rolling, tea-lead rolling, pipe, or smelting work, whereas such cases as have occurred,

two only in number, occurred in the white lead works in men who are subject to the risk of dust inhalation."

"On my first inspection, of 47 cases who showed some more or less obvious signs of lead infection, 34 were at work in situations that allowed of frequent inhalation of lead dust, whereas in the remainder of the cases, 13 in number, dust infection could not be entirely eliminated, but was not so certain as amongst the others.

Besides this, as has been pointed out in the section dealing with the relative degree of danger in the various departments, very few cases are seen in which dust can be eliminated entirely as a cause of infection. It is perhaps unnecessary to insist at so much length upon the importance of dust in the production of lead poisoning, but it is a by no means uncommon thing to hear it stated that the chief cause of lead poisoning is the taking of lead into the alimentary canal through errors in personal hygiene. Certainly in factory A, a very large improvement has taken place in the workers since 1903, and has coincided with the introduction of special washing arrangements to replace the old bowls then in use. The system now in use is that of a series of troughs, 18 inches wide, 9 inches deep, composed of glazed bricks, and having arranged throughout their length a series of sprays supplied with warm water by means of a controlling valve at the end of each series, each set of sprays being so arranged that the workman has only to bend down his face over the trough to ensure a thorough irrigation of the whole of his head."

"It is not an uncommon thing to find that the women engaged in cleaning up the offices attached to a white lead works, and also engaged in washing the overalls worn by the workers during their hours of employment, exhibit marked signs of lead infection, and in one or two cases have also shown acute forms of lead poisoning. This again is a question rather of dust than of the entrance of lead mixed with food or otherwise.

Channels of Infection.—We have sufficiently indicated in the foregoing remarks the main channel of infection to white lead workers and lead manufacturers. It is, however, possible that a considerable amount of the infection by means of lead dust does not take place directly through the lungs, but that the lead dust inhaled is precipitated upon the mucous membrane of the mouth, nose, and pharynx, and is thus swallowed, so forming an alimentary source of infection, although not taken directly into the mouth by way of unclean hands. Poisoning through the skin is an extremely uncommon occurrence, and is practically not met with except in exceedingly susceptible persons. In support of the comparative harmlessness of lead, even when it has an opportunity of forming an oleate, there may be mentioned the rolling of tea-lead and the lead used for wrapping packets of tobacco; this form of lead-sheet is rolled in small mills and the workers feed in the plates of lead by hand, rarely, if ever, wearing gloves. The surface of the roll is kept constantly moistened with oil, so that the surface may be properly polished, and if the hands of a lead roller be examined, they will be found to be covered with a thick layer of lead and oil, often taking on the composition of oleate, due to the temperature produced in rolling the lead. Notwithstanding this it is exceedingly uncommon to find any sign of lead poisoning amongst these workers. With regard to the handling of white lead the men engaged in washing the corrosions in the wash-beck do not show any marked incidence of lead poisoning, unless carelessness be shown in placing the corrosions in the wash-beck, as I have already pointed out; and yet the hands of these men are often almost raw through constantly picking up the lead plates with wet hands, the lead plates being extremely rough from the sharp edges left by the crystals of lead which have been picked out by the acetic acid, yet the men rarely show any signs of lead poisoning. It may be remarked in passing that to avoid chance of infection by means of the skin in workers engaged in wash-beck work I have caused a vessel containing glycerine, methylated spirit, and sulphate of magnesia, to be supplied for the men to dip their hands in from time to time. This tends to harden the hands, and prevents the dermis becoming quite exposed.

The cases of lead poisoning ascribed to skin infection are generally in women, and associated with the use of lead cosmetics, not with any manufacturing process.

A good deal of infection certainly does occur directly by means of the alimentary canal through the ingestion of food which has been contaminated with lead dust or by using unwashed hands. It does occur in this way amongst printers, and in one factory under my supervision, Factory C, where the processes of lead smelting, de-silverising, and litharge manufacture are carried on, no proper provision for washing was in vogue, nor was there any rule in force preventing the takings of meals in the factory, and amongst these workers a very large number of cases of lead poisoning, including paralysis and acute colic, were common. Since the introduction of rules more or less framed on the lines of the white lead rules, but as yet very imperfectly observed, some diminution in the number of cases has been noticed,* but a very great deal of danger owing to dust still exists which also assists in keeping up the number of cases to a higher point than is at all satisfactory. We may say, therefore, that the most important form of lead infection is by means of dust; and, secondarily, through the medium of food, tobacco, dirty hands, and perhaps an extremely small number of cases are due to its entrance through the skin.

Little more need be said of the ætiology of lead poisoning, while the domain of its pathology is scarcely germane to the present paper; but the symptoms, diagnosis and treatment deserve some attention. It was thought, however, that some facts of importance might be elicited regarding the ætiology of plumbism by experiments upon animals with regard to the relative poisonousness of the different compounds of lead. A series of experiments was therefore undertaken with a view to determining this point, and coincidently the onset of symptoms in relation to the form and manner in which the animal was infected."

"Owing, however, to the fact that this compound of lead (litharge) is ground in the dry state, the risks of dust are very much greater, and considerable quantities of very finely-powdered litharge escape from the disintegrator through any cracks or crevices existing, and even if there be no such dust escaping during the process, when the air ducts leading from these disintegrating machines are periodically cleaned, it is impossible to avoid huge clouds of dust.

In Factory C., with which I am familiar, very great efforts have been made to minimise the dust produced during the process of disintegration, and subsequent packing. A powerful exhaust fan is connected with the disintegrator by means of air ducts with the packing machine, through the medium of a large conical iron tank, in the interior of which is a balloon of fine canvas. The dust-laden air is led from the air ducts communicating with the machine into this balloon, and a very large amount of the fine dust is deposited therein, and is removed from time to time. Notwithstanding all these precautions, litharge dust is constantly flying about the rooms and kept in constant circulation by the belts of the moving machinery, which are not covered in, and by the leakage of dust from the edges of the packing machine, the sifter, and various other spots, causing the department in which this process is carried on to be one of the most dangerous in the whole of the factories I have discussed."

"The works themselves are also deplorably dirty, not perhaps owing to any real fault of the management, but rather to the very small amount of room upon which a number of processes are crowded, with very inadequate accommodation. Thus the dust on the windows of the manager's house frequently contains 20 per cent. of lead.

"It would be possible to make use of steam in the case of fine dust in the exhaust air-ducts and in the case of fumes from litharge furnaces. The waste steam of the engines, etc., could easily be utilised in the exits of the exhaust air-ducts and the frequent deposit of fine lead dust upon the roof of the factory prevented. That such prevention is important is shown from the fact that at least two cases of lead poisoning have occurred in the adjoining factory during the last three or four years in men who have never worked in a lead factory.

The fact of the dust on the house windows explains such an occurrence.

Respirators are worn by the men engaged in the litharge works, but the ordinary linen nose-bag respirator is not a particularly satisfactory method of preventing the inhalation of dust. Added to this, although simple overalls are worn, the men's faces beyond the respirator, hair, and ears become full of

* Since this was written the number of cases of poisoning in this factory have considerably diminished, both in severity and number, the washing and bathing rules having been stringently enforced and exhaust ventilation installed.

litharge dust, and up to only a short time ago there was very little adequate washing accommodation for the men engaged in the works. Some improvement certainly has been obtained in these works by the adoption of a series of rules framed after the fashion of white lead rules in force in other factories, and washing accommodation is provided.* At one time it was no uncommon thing, upon inspecting the men at one of the shifts—the factory for the most part working continuously on eight-hour shifts—to find a man who had just returned to the factory after his eight hours off for sleep returning in exactly the condition in which he had left off his work, having gone home, eaten and slept, without once washing himself. No amount of dust-prevention or legislation for the prevention of dust can deal with this utter callousness in personal hygiene, and it is not to be wondered at that the occupiers and managers of lead works, particularly smelting and de-silverising works, should become callous to the condition of the men who refuse to adopt even the smallest precautions on their own account towards the prevention of poisoning in what must always be a more or less dangerous occupation, and the difficulty of the medical officer is thus greatly increased when any suggestions as to reduction of dust production or other improvements are made, the occupier or manager at once rejoining: "We are quite willing to do such things, but what is the good when the men will not even wash their hands"; and unless some stringent regulation be enforced there is no possibility of making these men observe proper personal hygiene. Since the erection of the washing apparatus and the attempt on the part of the factory, at my suggestion, to enforce rigidly the rules of washing, the number of cases of lead poisoning reported at this factory has distinctly decreased, but its potentiality for lead poisoning is still very great."

"It is a common saying, and a matter of common knowledge, that no animals, dogs, or cats can be kept for more than about two months in a lead factory, as they rapidly develop signs of lead poisoning and ultimately die. In Factory C considerable efforts have been made, and are being made, to prevent the poisoning occurring by the owners and manager of the factory; suitable washing accommodation, meal room, etc., have been erected, and yet it is most difficult to persuade the men to go into these places to have their food—they prefer to sit down by their furnace or pot and eat their food on the dust-laden floor. It will only be possible to obtain proper control if a series of proper regulations are drawn up and issued by the factory authority of the Home Office to give the managers, and also the appointed surgeon, the fullest authority to enforce the simple regulations of hygiene, which will go a long way towards preventing poisoning in these factories. With regard to methods of prevention of a hygienic type that may be applied mechanically to remove the dangers of poisoning, the chief are the proper provision of all stoves, furnaces, and, if necessary, melting-pots with hoods connected with exhaust fans."

CHAPTER III.

Statistical Evidences relating to Lead Poisoning.

"The enforcement of the abolition of female labour affected the 'white beds,' and this gave employment to a considerable number of new hands, and so somewhat increased the number of first attacks during the specified period. At the same time, it is exceedingly important to observe that from one to six months appears to give the largest incidence of first attacks, and this is borne out by the experience gained by the inspection of the men in the factory A, where I have been able to show the length of time of employment before any symptoms of lead poisoning were sufficiently marked to warrant suspension from work, either with a view to resuming or entire suspension from further work in lead."

"The question of occurrence of blue line in lead poisoning, and its relation to the number of cases occurring in any factory, has been noted in passing, but no figures were given. I have carefully collected the number of cases, showing blue lines, in factory A, since 1902. During the period 1902-3, 3,551 cases were examined, and of these 3,045 showed the presence of blue line. I have no exact figures for the poisoning occurring over this period. During 1903-5, 6,622 inspections were made, and in these 1,173 showed the presence of blue line: during this time, two cases only of poisoning, and 23 cases of suspension were noted. These figures support my contention in the section upon lead poisoning that the presence of blue line cannot at all be regarded as a diagnostic feature of general poisoning. It, however, points of course, as has already been stated, to dust infection."

"The most marked diminution of cases of poisoning in any figures to which I have had access, seems to be in the factory de l'Union Minière de Bleiberg, quoted by Ignace Kamp, where, with the introduction of mechanical appliances replacing hand labour, the cases per cent. diminished in number from 55·2 to 19·1 over a period of ten years, although the production of red lead of the factory rose from 383,000 kilogrammes to 670,109 kilogrammes. It is very evident that the change from hand labour to machine labour not only reduced the chance of infection by handling the lead, but must have largely reduced the amount of dust. Although so much stress has been laid upon dust as a source of infection, I do not wish to minimise the danger which is occasioned by taking food with unclean hands. This is particularly the case in those factories, such as silver refineries, and in de-silverising processes, which are also carried on in Factory C, to which I have already referred.*

CHAPTER IV.

Medical Aspect of Lead Poisoning.

Symptoms and Diagnosis of Lead Poisoning.—Upon reference to the statistics given in the Reports of the Inspector-Chief of Factories in England, it will be seen that the largest and most important group of symptoms associated with lead poisoning are gastric. Thus, out of 143 cases of white lead poisoning, 119 were gastric, or had gastric symptoms as their most pronounced feature. In 1902, 84 per cent. of the cases of white lead poisoning were gastric in their main symptoms, and 79 per cent. of them were first attacks. It appears, therefore, that gastric symptoms, as is generally stated, are by far the commonest; in fact, in other industries in which lead is employed, for instance, in china and earthenware, the number is large, but not quite so high as amongst the white lead workers, 66 per cent. and 76 per cent. being the figures for the two years 1902 and 1904 respectively. In the paint industry again, in 1902, 78 per cent. of the reported cases had gastric symptoms as their leading features, and in 1904, 88 per cent. The cases of paralysis are not so common, forming only 10 per cent. of the cases of white lead poisoning in 1902, in the earthenware industry they formed 15 per cent. Amongst the file cutters, the percentage of cases of paresis is very large; in 1902, 18 cases of poisoning in file cutters gave 12 cases with paralytic symptoms, 66 per cent.; in 1904, of 14 reported cases, 5 were paralytic, 35 per cent. Another common form of symptom frequently complained of in men subject to the effects of poisoning by lead are rheumatic pains; a fairly large number of cases, 11 per cent. in 1902, having had rheumatic symptoms as a leading feature. But by far the most common symptoms of early lead poisoning is anæmia, and anæmia of a somewhat curious type. In my own experience, anæmia is the most common premonitory sign

* See foot-note, p. 50.

of infection by means of lead. Together with this anæmia, of which more must be said later, a curious loss of fat takes place, particularly noticeable in the orbit and in the buccinator region of the face. The naso-labial folds become distinctly marked, and another fold, situated at a slight distance to the outer side of the nasal folds, makes its appearance corresponding to the anterior margin of the masseter muscle, giving the face a curious pinched appearance, which is one of the factors making up the singular saturnine cachexia. It is not a little interesting to note that in animals (cats), which have been poisoned by exposure to lead dust, the wasting of the orbital fat, together with the curious pinched appearance of the face, is one of the first symptoms which usher in the more grave conditions of colic and paralysis. Men who have been engaged in white lead works for a considerable period exhibit the curious facial expression described, in a marked degree, even when there is no very well-marked anæmia, and no other marked manifestation of lead intoxication.

Following on the anæmia, and often coming on without any symptoms of anæmia, it is common to find lead workers suffering from fine tremor; it is often difficult to distinguish between the tremor of lead poisoning and that due to alcohol, but the history of alcohol and other signs of an alcoholic habit must be relied upon for the differential diagnosis. It is undoubtedly the case, however, that persons who are exposed to white lead dust, and who are in the habit of taking large quantities of alcohol, are much more liable to contract lead poisoning than are persons who are abstemious in this respect. Another early sign of lead poisoning through the agency of continuous small doses daily inhaled is a marked tendency to mental lethargy, much as is observed in the experimental animal subjected to the action of white lead dust. In fact, I have begun to regard a general condition of sleepiness, especially when a man of otherwise good record and who does not show any obvious signs of anæmia begins to fail to appear at the factory in proper time in the mornings, as an early sign of poisoning, and I have frequently observed that this lethargic condition is somewhat later followed by the appearance of tremor, and generally, if the exposure to infection is continued without interruption, gastric symptoms supervene. In a small number of cases eye symptoms occur, but as a rule these do not form any large percentage of cases, and they are also generally associated with a very considerable amount of infection due to gross carelessness, so that with the present system of inspection in force in white lead factories they are but rarely seen.

Kidney disease is a very common concomitant of continued dosage with lead, but as a rule does not supervene for a considerable amount of time, and although there may be much heightened pulse-tension, and perhaps a great deal of degenerative change ultimately in the kidney, it is so often associated with kidney degeneration of an alcoholic type that it is extremely difficult to differentiate the two conditions. It should, however, be borne in mind that a worker showing manifest signs of kidney disease, or whose urine shows the presence of albumen, must not be employed in a lead factory in any situation where he is liable to be exposed to the inhalation of lead dust.

Cerebral symptoms occur only in a small percentage of cases and are not common in white lead workers. Thus in 1902 the percentage of cases of encephalopathy were only 6 per cent. of the total number of cases, while amongst the file cutters the percentage was 11·1 per cent. This condition is more usually associated with small doses of metallic lead over very long periods and may be considered to be one of the final symptoms of a long course of chronic metallic lead poisoning.*

Blue Line.—The Bertonian line or blue line commonly associated with lead poisoning, perhaps, should be discussed here. I may say at first that I have come to regard it as of no importance in the diagnosis of lead poisoning where dust is the source of danger, for in these cases, that is where dust is inhaled, a blue line may be seen in the mouths of workers who have only been in the lead factory for one day. It is, of course, not pronounced in such cases, but still exists as a small, well-marked blue line surrounding the edges of the gums, but only around such teeth as have some pathological condition of the gum and not around teeth which have healthy gums and are not affected by deposits of calculus or other irritation. The explanation is very simple; in all these pathological conditions of the gum, often summed up as pyorrhœa alveolaris, along the gum margin in the suppurating areas bacteria are present which are capable of producing sulphuretted hydrogen. Any carbonate of lead therefore which gains access to the mouth is easily turned into sulphide, and, becoming deposited in or around the gums, forms a blue line of lead sulphide. I have, however, observed that as it is a common occurrence to have chronic gastro-intestinal symptoms, intestinal indigestion, and frequently a considerable degree of anæmia directly caused by the ingestion of the suppurative products from the gum-margins in cases of alveolar pyorrhœa, and further that the pus around the gum margin is frequently due to bacteria pathogenic to a marked degree, such a condition may undoubtedly predispose to direct lead infection, for only a small portion of the lead is turned into sulphide in the mouth, the remainder being swallowed, often combined as an extremely soluble peptonate with the peptone resulting from partial decomposition of food which has remained stranded about the teeth. I have, moreover, observed that in cases of alveolar pyorrhœa, that is to say what we may for practical purposes term septic gums, there is a distinct lowering in resistance on the part of some people to the special bacteria which can be obtained from the mouth, and I have actually observed that in the three factories under my own personal supervision, containing between 300 and 400 men, cases of colic are more often developed in those men whose mouths show the above-mentioned septic condition than in those workers who are in the habit of observing the usual precautions of mouth hygiene. I therefore consider the blue line observable upon the gums to be rather a sign of the presence of lead dust in the part of the factory where the worker is engaged, and that it would be well to enquire especially into the working of that department should any number of cases of blue line make their appearance. But as to regarding it as of diagnostic importance as a sign of lead poisoning, the evidence is very small, and it is impossible to diagnose a case of lead poisoning from the mere fact of a blue line around the gums.

Anæmia.—The anæmia of lead poisoning is frequently most pronounced, the blood-count being as low as 1,500,000, with a low hæmoglobin of, perhaps, 40 per cent. to 45 per cent. There is no leucocytosis of any considerable degree, and very little to mark it from any of the ordinary secondary anæmias. Some little time since the presence of minute basiophilic granules in the red blood corpuscles (Phlen's bodies) were stated to be of considerable diagnostic importance in connection with lead poisoning. These granules are, however, frequently present in any form of anæmia and may be present in the blood as a result of anæmia of malarial origin, and in several cases amongst the Italian workers, as well as in several English workers, who had served in the army on foreign stations, I have found these bodies present in men who presented themselves for examination before commencing work in the lead factory. We can, therefore, scarcely regard these bodies as of diagnostic importance, their presence only pointing to a considerable amount of blood destruction.

Constipation.—Another of the common symptoms, and one frequently present in the early stages of lead poisoning, is a moderate to severe degree of constipation. The bowels may not be open from three to five days, when the attack generally terminates in colic. Early treatment of the constipation may ward off the colic, but on the other hand may only delay it for a week or ten days. A mild degree of constipation, not complete, in which the motions are irregular and scanty, may continue for many days and even weeks, and it is also common to find associated in these chronic cases well marked hæmorrhoids, and a particularly full pulse, such as is common in any old case of chronic constipation.

The cause of this particular symptom is of considerable interest in view of certain animal experiments that have been performed by Oliver, and described in his "Milroy Lectures," and which I have also confirmed myself. In animals poisoned by means of small doses of acetate or carbonate of lead, when a marked degree of constipation associated with colic has been set up, at the autopsy the intestinal canal is found to be at various intervals in its length, in a state of what may be termed tetanic contraction. The condition of the intestines much resembles a string of sausages,

* In this connection, see Appendix XXV., page 56.

the constrictions being due to the contraction of the circular muscular fibres of the intestinal coat.

Oliver has suggested in the "Milroy Lectures 1891," with, I think, a considerable degree of certainty, that the condition of the intestine may be regarded as of nerve origin, probably mainly associated with the solar plexus and ganglia of the sympathetic nervous system. On such a supposition the treatment suggested by Gauch, in the administration of belladonna in considerable doses for the treatment of lead colic, and also for the treatment of chronic constipation occurring in lead workers, is in all probability based upon a correct assumption of the cause of the constipation. Further, I have observed that in cases of chronic constipation occurring in lead workers the administration of strychnine may very often determine the onset of colic. The colic would appear to be due to the partial contraction associated with local dilatation and to a diminished motor power, together with impairment of peristaltic action.

It is needless to enter into any great discussion on the forms of colic or its diagnosis, but it may be stated in passing that not a few cases of enteric fever, appendicitis, and ptomaine poisoning are from time to time notified in England as cases of lead poisoning, particularly when occurring in employees of lead factories. The differential diagnosis is one that is to be left to the appointed surgeon, as a matter of course, but in passing it may be stated that in lead colic, in the majority of cases, the pain is momentarily relieved by firm pressure upon the abdomen.

The alteration of the pulse-rate during paroxysms of colic is very noticeable, and may be reduced to as few as 20-30 beats per minute, rising again to its normal rate or higher in the interval.

Tremor.—Fine tremor is frequently seen in lead workers exhibiting no other signs of poisoning, and should always be looked upon with extreme suspicion, and as a possible indication of threatened paralysis. Its presence certainly points to some degree of nerve irritation, and at times if the tremor be marked, increased nerve reflex may be elicited. The tremor is difficult to differentiate from that of alcoholic poisoning, but is generally extremely fine, and often associated with isolated fibrillar contraction of surface muscles. It is best noticed when the hands are extended pronated, and with the fingers widely separated. Tremor frequently precedes wrist-drop by 18 months to two years.

Wrist Drop.—This phenomenon, constantly associated with lead poisoning, is by no means so common as it was in the lead factories in Great Britain before the introduction of the special rules for white lead factories. It does, however, still occur, but is generally due to a prolonged course of poisoning associated with alcoholism. Finger-drop also occurs, and is more common than the total dropping of the wrist. Either affection is due to alteration in the nerve supply of the extensor muscles, and the interossei. It is therefore generally followed by wasting and general tropic degeneration of the affected muscles, the extensor communis digitorum suffering to a marked degree. Although affection of the wrist is the most common variety of poisoning, several other forms have been described and do at times occur, such for instance as the degeneration of the muscles of the foot, of the shoulder and the back, in the region of the arm. These however are matters of rare occurrence, and in my opinion should not occur in a factory where proper hygienic precautions are properly followed out, on the lines which I have indicated in the section devoted to that subject. It is not uncommon to find some degree of alteration, perhaps not amounting to definite coordination of the gait of lead workers who have been employed during long periods in positions which expose them to poisoning from metallic lead or the oxides of lead. They may also occur in white lead factories where continued and chronic poisoning has been allowed to take place. Eye changes, with amaurosis, retinal degeneration, etc., may also occur, but these again are more related to chronic continued poisoning than to acute forms.

The paralytic forms of Saturnism may occasionally occur in persons peculiarly susceptible to the effects of lead after working for but a short time in lead processes, but by far the largest number of cases of paresis occur in workers who have for many years followed occupations exposing them to lead fume or metallic particles.

Treatment and Prevention.—The main point of consideration in the treatment of lead poisoning naturally rather resolves itself into the prevention of the sources of infection rather than the treating of symptoms when developed. I have already pointed out how much more important is dust as a source of infection than any other form, even the eating of food with hands soiled with lead.

No worker should be allowed to commence his work during a fast, and in many of the English factories a free meal of bread and cocoa is supplied to any of the workmen who will come into the works ten minutes before the hour for starting work. Unfortunately it is not all who avail themselves of this provision.

On ceasing work, efficient washing is of the greatest importance. In English factories ten minutes is allowed to the workers to wash before the hour of closing. In two of the factories under my control a special washing apparatus has been erected, as has been pointed out in a previous part of this paper, and with the most beneficial effects, the action of the stream of water from the fine rose being much more efficacious in removing particles of white lead than the ordinary sluicing performed with a hand-basin. Soft soap is generally supplied to the white lead workers, and a nail brush extending the whole length of the washing trough is screwed to the wall so that it cannot be removed and is always ready for use. Baths are provided, and, according to the English regulations, each white lead worker must take a bath once a week in the specially-provided baths and must sign his initials in the book kept for the purpose, which must be countersigned by the bath-man in charge of the lavatories.

All white lead works in England have a medical officer, who is termed the appointed surgeon and who inspects the whole of the workers in the factories at least once a week. No worker is allowed to commence work in the white lead factory until he has been certified as being in a fit and proper condition by the surgeon. If this regulation be efficiently carried out a great many cases of lead poisoning would be eliminated. Young persons, particularly young persons who show some amount of anæmia, those suffering from kidney disease or with high arterial tension, as well as persons with unclean mouths or those suffering from any degree of lung trouble, should be eliminated as unfit to undergo the risks which may be run in this form of employment. At the weekly examination the notes of each individual worker are recorded in a book kept for that special purpose, and any notes or recommendations are entered into an appropriate column.

In British factories the appointed surgeon has full discretion and power as regards the suspension of any men working and as to alterations of a reasonable nature that should be made with regard to hygienic provisions. He may also direct that any worker should be changed to another part of the factory where he is less liable to infection. A great deal may be done under these rules to keep the cases of poisoning under control, and to shift the men engaged in some dangerous process to one where they are not so likely to become affected, and where there is some possibility of their regaining health under proper treatment, the necessity for entirely suspending them from their occupation, with its accompanying hardships, being thereby to a great extent avoided. It should be always borne in mind by the appointed surgeon that it is not a sufficient method of procedure to merely suspend from their work men who show some sign of lead poisoning, but that he must regard himself rather as appointed as a custodian of the men's health, and therefore of their ability to earn their living. On the other hand, it frequently happens that carelessness or intemperance on the part of a worker is one of the greatest contributing causes to his becoming poisoned, and therefore such a man, in order to be protected against himself, requires to be suspended from a dangerous trade; in addition, there are a certain number of persons who exhibit a peculiar susceptibility to lead poisoning, and in the course of my investigations I have observed four families where three, and in one case four, members of the same family became the subjects of lead poisoning within three years. In two instances, after having observed one man becoming poisoned by lead, I kept particular watch upon his brother, and found that this relation showed signs of poisoning before other members of the same gang of men working in the same position and for the same length of time. In the case of the four members of one family becoming affected, the father, two brothers, and sister all became infected within a period of three years. That may perhaps be merely a coincidence, but

I have come to regard the fact of one member of the family showing lead poisoning as an indication to keep particular watch upon the other members of the family working in the same factory.

Medical Inspection.—A very great deal of importance devolves upon the efficient inspection of the employees exposed to white lead poison. In England this inspection is performed at least once a week, the whole of the men being passed before the doctor; he should examine each of them carefully, and this may be done efficiently in a very few minutes. The following general schedule of the points to be noted has proved of considerable value in my own hands for the detection of early cases:—

1. General appearance of face—anæmia, especially noting colour of lips and conjunctivæ.

2. Pulse—hard, slow, or soft and running.

3. Speech, which in early cases often becomes slow, hesitating, and indistinct.

4. The hands are held stretched out towards the observer, and any presence of tremor noted. The fingers are then stretched apart to note the action of the interossii; the wrists are then lowered and again made to assume the extended position. The hands still being extended and the fingers strongly separated, the spring of each finger is noted by placing the surgeon's thumb upon the dorsal aspect of the finger, his first finger on the palmar surface of the hand, and pressing sharply with the thumb. If any weakness be noted, the patient should clench his fist, and the surgeon should note the amount of power required to flex the wrist whilst the man opposes it.

The mouth is then examined, and presence or absence of blue line noted. If a faint blue line near the edge of the gum is noted, this probably shows that the man has been exposed to inhaling white lead dust. If he be a worker in a situation where the use of respirator is necessitated, enquiry should be made, first as to whether the respirator has been worn continuously; secondly, if an unusual quantity of dust has been produced; thirdly, if an extra amount of dust has been produced, was it due to carelessness on the part of the man, a breakdown in any part of the process, causing interference with the methods of dust-extraction; or has the character of the corrosions in the white lead beds been of a softer nature than usual.

If the blue line be not confined to the margin of the gums, but appears as a thick stain throughout the whole of the gum for some distance down from the teeth, a considerable degree of poisoning may be presumed to exist. Men rarely get this condition of poisoning unless they have been working for some time in a dangerous position, and more particularly young people six weeks to two months after commencing work in a white lead factory. The blue line must not be confounded with the dull, bluish appearance constantly seen in cases of pyorrhœa alveolaris, which is not infrequently mistaken for a lead line.

The gait should be studied, as the man walks up to and away from the surgeon. Any case of dropped foot, and even unsteadiness may be thus noted. This is not common, and in almost all cases either a finger or the wrists are the most likely to show weakness first.

With regard to subjective symptoms, as a rule, these are of little value, as it is frequently difficult to obtain a correct answer to a question, the men preferring to disguise any symptoms of pain or illness of which they might otherwise complain, and the surgeon must, as a rule, be more guided by what he sees than by what he is told. A great deal of this reluctance to correctly state symptoms is due to the fact that in many factories it has been the custom to at once discharge any man who showed the slightest sign of lead poisoning, thereby preventing him from following an employment with which he is familiar, and preventing him also from obtaining employment in other lead factories, as the workers who have been discharged on account of lead poisoning from one factory are not taken on again at another one. Perhaps the best way to combat this reluctance on the part of the employees would be to provide them each on commencing employment in a factory, with a small, simply-worded pamphlet, giving them the dangers of their work, the methods of avoiding such dangers, the early symptoms, and the fact of the advantage of early treatment in preventing both serious poisoning and therefore loss of employment. Further, it should be pointed out in such a book that the doctor who examines the men at regular intervals is the proper person to complain to of any early symptoms, and that he will only prevent persons from working who either are peculiarly liable to the effects of lead poisoning, or who are suffering from some other disease, which, although mild in itself, perhaps, is likely to predispose to, or cause to be more severe, any effects of lead poisoning.

The subjective symptoms of interest to the surgeon are:—

1. Constipation.
2. Giddiness and vertigo.
3. Colic.
4. Alteration in sight.
5. Rheumatic pain, not traceable to other causes, and
6. Headache.

and have already been referred to.

The various signs used by the surgeon to indicate any particular objective symptoms, also notes of general appearance on examination, are to be noted at once in a book especially kept for the purpose, and as the cases are examined week by week, it is possible to see any variations in the condition of men either in one department or as a whole. Considerable evidence is thus given as to whether the proper regulations are being carried out in an efficient manner. Thus, I have on more than one occasion detected a laxness in the watering of the floor by noting the increased number of persons who showed the blue line in the special department situated near to the one in question. The appointed surgeon should always bear in mind that it is extremely easy to water the floor of the factory once a week before his arrival.

Another point of very extreme importance, and one in which the surgeon can greatly assist, is the endeavour to obtain a large number of regular hands as opposed to casual hands, who only work a few days at a time. The incidence of lead poisoning in casual employment is, according to the special Report on White Lead Works, by Dr. T. M. Legge, in 1898, 39 per cent. for casual, whilst the regular employment only gave 6 per cent.

One of the foremen of the works, preferably the chief foreman, who generally acts as sub-manager, should be responsible for the upkeep of the washing appliances, and also for the prevention of dust. He must also see that overalls in a proper state of repair are used by all workers, and that no clothes which are likely to be used outside the factory are worn during working hours. He should also see that the overalls worn by the men in the especially dusty processes, should, at the end of each working day, be deposited by the men when they take them off in a suitable receptacle containing water; for in at least two instances the washerwomen engaged in washing the overalls have developed lead poisoning. The foreman should also have charge of suitable medicines prescribed by the appointed surgeon, which should be kept upon the factory premises, and should be given to the men as the surgeon directs. In this way it is possible to treat any case of poisoning in an incipient stage, and make sure of the men obtaining the proper treatment; it is not uncommon for them to refuse or omit to take the medicine prescribed for them if taken away to their own homes. The foreman should have a supply of an aperient mixture to give to any man who requires it. The formula which I have found efficient contains sulphate of magnesia, sulphate of soda, Tr. belladonna, and a small amount of iron in the form of citrate. A mixture containing citrate of iron and iodide of potash may also be kept for cases of anæmia, to be given as directed by the surgeon.

No wines, spirits or beer, or alcoholic liquor of any description should be taken into the factory. All workers should be encouraged to make use of onions and garlic in their diet, and this may perhaps in some degree explain the relative immunity exhibited by Italians engaged in white lead manufacture, who consume considerable quantities of garlic.

EXPERIMENTS WITH GASTRIC JUICE.

The following Table gives the tabulated results of the examination of the solubility of lead sulphate, white lead dust, and litharge in gastric juice obtained from the stomach of normal persons. The gastric juice was obtained by means of a stomach tube passed into the stomach, and is the gastric juice secreted

after a fast for the digestion of a simple test meal. The gastric contents were filtered and divided into portions, to each of which was added a proportion of the lead salt to be tested. The tubes were then digested for an hour at body temperature, their contents were filtered, and the filtrate was analysed by titration with an ammonium molybdate solution of which one cubic centimetre was equal to 0·0008 grms. of lead. The analysis of the two specimens of gastric contents are also given, and it will be seen that the first is a perfectly normal gastric juice, the second one of hyper-acidity. In the second experiment it was thought that some of the sulphate might have passed through the filter, and the tubes were therefore centrifugalised, and the amounts for estimation drawn carefully from the top.

The result of these experiments is decidedly interesting, and shows that the lead sulphate, generally regarded as the most insoluble of lead compounds, is almost as soluble as either white lead or litharge, in fact in one case more so. These experiments therefore suggest that the solubility of lead sulphate rather tends to throw doubt on the advantage to be gained by the use of dilute sulphuric acid as a sanitary drink.

SOLUBILITY OF LEAD SALTS IN HUMAN GASTRIC JUICE.

METHOD—Gastric juice was obtained from two persons by means of a stomach tube introduced after a test meal had been taken fasting, and immediately filtered.

Total Acidity=Number of ccm. of $\frac{N}{10}$ NaOH required to neutralise 100cc. filtered gastric contents to end point phenolphthalein 1% sol. in 50% alcohol.

Volatile Acidity=Number of ccm. of $\frac{N}{10}$ NaOH required to neutralise 100cc. distillate gastric contents to end point phenolphthalein 1% sol. in 50% alcohol.

Digestion No. 1=Number of minutes taken for filtered gastric contents to produce free carmine in carmine stained fibrin.

Digestion No. 2=Number of minutes taken for filtered gastric contents to produce free carmine in carmine stained fibrin; digest acidulated with an equal volume of 1 % HCl.

Digestion No. 3=Number of minutes taken for filtered gastric contents to produce free carmine in carmine stained fibrin; digest diluted with an equal volume of distilled water.

EXPERIMENTS.—GASTRIC JUICE No. 1, obtained after test meal, and filtered:—

Quantity	160cc.	
Reaction	acid	
Hydrochloric acid	present	
Lactic acid	present	
Butyric acid	present	*Normal condition.*
Mucus	present	
Total acidity	100cc.	
Volatile acidity	5cc.	
Digestion No. 1	4 minutes	
Digestion No. 2	4 minutes	
Digestion No. 3	5 minutes	

Three samples were tested as follows:—

(1) To 10cc. filtered gastric contents was added Lead Sulphate 0·1 gm. and digested at 37° C. for 1 hour
(2) " " " " White Lead Dust 0·1 gm. " "
(3) " " " " Litharge Dust 0·1 gm. "

The samples were then filtered and titrated with ammonium molybdate solution 1cc. = 0·0008 Pb.

(1) Lead Sulphate 1·0cc. = 1·0cc. molybdate sol. = 0·0008 Pb = 0·08 %
(2) White Lead 1·0cc. = 0·6 " = 0·00048 = 0·048
(3) Litharge 1·0cc. = 0·5 " = 0·00040 = 0·040

GASTRIC JUICE No. 2. obtained after test meal, and filtered:—

Quantity	130cc.	Total acidity	111cc.	
Reaction	acid	Volatile acidity	8cc.	
Hydrochloric acid	present	Digestion No. 1	8 minutes	*Hyperhydrochloridia.*
Lactic acid	present	Digestion No. 2	6 minutes	
Butyric acid	absent	Digestion No. 3	4 minutes	
Mucus	absent			

Six samples of 10cc. were tested—

(1) Lead Sulphate + 10cc. filtered gastric contents digested at 37° C. 1 hour
" 0·1 0·1 gm. + 10cc. " " " "
(2) White Lead 0·1 gm. + 10cc. " " " "
" 0·1 gm. + 10cc. " " " "
(3) Litharge 0·1 gm. + 10cc. " " " "
" 0·1 gm. + 10cc. " " " "

All digestions centrifugalised and 2cc. taken for estimation.

(1) Lead Sulphate - -	2cc. required.	1·25cc. molybdate solution	= 0·001 gm. Pb.	= 0·050 %	
	2cc. "	1·0cc. " "	= 0·0008	= 0·040	
	2cc. "	1·20cc. " "	= 0·00096	= 0·049	
	2cc. "	1·15cc. " "	= 0·00092	= 0·046	Av. 0·0462
(2) White Lead - -	2cc. "	1·10cc. " "	= 0·00088	= 0·048	
	2cc. "	1·0cc. " "	= 0·00080	= 0·040	
	2cc. "	1·05cc. " "	= 0·000816	= 0·040	
	2cc. "	1·05cc. " "	= 0·000816	= 0·040	Av. 0·0422
(3) Litharge - - -	2cc. "	0·86 " "	= 0·000688	= 0·0344	
	2cc. "	0·90 " "	= 0·000720	= 0·036	
	2cc. "	0·80 " "	= 0·000640	= 0·032	Av. 0·034

Summary of Results	GASTRIC DIGESTION.	No. 1.	Lead Sulphate	0·08 %
			White Lead	0·048
			Litharge	0·040
		No. 2.	Lead Sulphate	0·046
			White Lead	0·042
			Litharge	0·034

Suggested Leaflet for distribution to workers in Lead Factories.

LEAD POISONING AND HOW TO PREVENT IT.

Q. How is lead poisoning caused?

A. (*a*) By breathing lead dust.
  (*b*) By eating lead with my food, because my hands have not been washed, or by leaving my food in a dusty place.
  (*c*) By smoking, chewing, or eating before first washing my mouth, or by chewing and eating while I am working in a place where I am breathing lead dust.

Q. What makes a man most easily poisoned by lead?

A. (*a*) Drinking too much beer or spirits.
  (*b*) Commencing work when hungry.
  (*c*) Want of fresh air in sleeping rooms and living rooms.

Q. What is the first sign of lead poisoning?

A. (*a*) The bowels not working properly.
  (*b*) Face becoming white, hands beginning to tremble.
  (*c*) Pain in the stomach.

Q. What must I do to prevent myself becoming poisoned?

A. (*a*) Make no dust in moving any lead (white lead, red lead, litharge, pot skimmings, flue dust, fume, slags, dross, etc.).
  (*b*) Wash out my mouth many times a day and keep my teeth clean.
  (*c*) Wear a respirator in any place where there is lead dust.
  (*d*) Wash my hands, face, and hair after work and before meals; take a bath as often as I can, at least three times a week.

Q. What is my duty to my fellow workman?

A. To make no dust that I can help and to prevent him making dust whenever I can.

Q. What is my fellow workman's duty to me?

A. To make no dust that can be helped.

Q. What are the special rules?

A. Rules that have been made to prevent workmen becoming poisoned by lead; these rules have been very carefully made by people who understand all the dangers of lead poisoning and who wish to prevent poisoning, so that the workmen may not suffer ill-health or loss of employment.

Q. Why are all the men examined by a doctor every week or month?

A. To prevent lead poisoning and to give medicine, or to change the work of a man to a less dangerous place if necessary, and to prevent carelessness of the men; one careless man by working badly and making a lot of dust may easily poison three or four other men.

Q. Why must I tell my foreman or the doctor if I have been feeling ill?

A. Because lead poisoning does not always begin at once with pain in the stomach and the doctor may be able to stop me being poisoned before I am too ill to go on working in a lead factory.

Q. Who are not fit to work in lead factories?

A. Men who are hard drinkers and a very few men who have weak health and are easily and very soon poisoned by lead.

Q. Why is a man sometimes stopped for a week or more by the doctor?

A. Because he is beginning to be poisoned and a rest and medicine will save him from being stopped working altogether.

Q. Why must I carry out and follow all the rules of the factory?

A. Because they are made for my good and that of the people who depend on me.

Q. Is working in a lead factory a very dangerous thing?

A. No; if a man takes care to do what he is told in the rules and is careful he need not become poisoned. Poisoning is generally due to carelessness of the men in their work, which can very often be prevented.

APPENDIX XXV.

PROGRESS REPORT ON EXPERIMENTS RELATING TO LEAD POISONING.

By Kenneth W. Goadby, Esq., M.R.C.S., D.P.H., etc.

The investigations have been pursued on the following lines with a view to elucidating certain points upon which the Committee required special information, namely, the relative poisonousness of low solubility (fritted lead) glaze and high solubility (raw lead) glaze and evidence relating to the comparative ill-effects of lead dust taken through the lungs and through the stomach, together with the *post mortem* symptoms of lead poisoning.

Animal experiments have been conducted as follows:—

1. Feeding experiments with low solubility and high solubility glazes.
2. Feeding experiments with the special lead constituent used in compounding: (*a*) low solubility glaze; (*b*) high solubility glaze.
3. Breathing experiments with low solubility and high solubility glazes.
4. Investigation of the Absorption and Osmosis of lead compounds, such as are used in glazes, through animal membranes under varying conditions, particularly with a view to determining its absorption through the lung.
5. Physiological digestion experiments with low solubility and high solubility glazes and the compounds of lead used in such glazes.

In addition to the above, information likely to be of importance to the Committee has been obtained, by means of feeding and breathing experiments with lead compounds other than glazes. With regard to:—

6. Ill-effects of lead dust taken through the lung as compared with that taken through the mouth and stomach.
7. *Post mortem* indications of lead poisoning.

Feeding Experiments.

Number of animals experimented with—11.

From a consideration of the statistics of poisoning in potteries, and of the material used in those processes in which lead poisoning occurs, two facts have already been established, firstly that the poisoning is distinctly related to dusty processes, and secondly that the processes in which the fritted lead is used do not exhibit the same severity of incidence of saturnism as do the processes in which raw lead is used.

It was therefore thought necessary for the purposes of the Committee to investigate the relative poisonousness of two varieties of glazes in use, namely, glazes compounded with fritted lead giving a low solubility test, and those glazes containing raw lead which give a high solubility test.

It is of course clear that the poisonousness of any glaze depends upon the solubility and absorption of its lead constituent by the animal body. So far as the feeding experiments were concerned, there appeared to be no difference between the action of dry white lead, fritted lead, a low solubility glaze, or a high solubility glaze, as in no case did the animals show any signs of poisoning within six months.

Method.—In the feeding experiments with the solid compounds of lead or with lead-containing glazes, the material was mixed with the animals' food, as this method would more nearly approach the industrial conditions for the following reasons:—(1) A workman is more likely to take a quantity of lead into his stomach in the form of dust which has become entangled about the mouth, during a meal, than at inter-meal times; and (2) no gastric juice is poured out

into the stomach until the bolus of food reaches the stomach, and even then the stomach-contents do not become acid till from fifteen to twenty minutes after the food is swallowed.

Compounds Used.—The compounds used in the feeding experiments were:—A low solubility and a high solubility glaze; a low solubility fritt, such as is used to compound low solubility glazes; white lead, such as is used for compounding high solubility (raw lead) glazes; a soluble lead salt.

The feeding experiments were therefore performed with:—

(*a*) Glazes as used industrially.
(*b*) Poisonous portions of the glaze.
(*c*) A highly soluble compound of lead in the form of a solution of lead nitrate. This compound was not given at meal times, but was added to the water consumed by the animals, so that small doses were taken at frequent intervals daily.

Quantity of the Substance Used.—The dose of the solid lead compound given to the animals was in every instance 1 gramme per diem. With the liquid added to the water consumed by the animals, the dose was ·01 gramme per diem.

Result of Experiments.

The animals fed on low solubility glaze, high solubility glaze, lead frit, and white lead, exhibited no symptoms even after so long as eight and fourteen months. A control animal kept in the laboratory during the whole time, and fed in exactly the same way, but without lead, remained constant in weight with the usual small fluctuations, whereas in every case of the animals fed with lead compounds, the weight at first increased, and then diminished until about one-third of the animal's weight was lost, but no other objective symptoms of lead poisoning were to be seen.

The animals fed upon the soluble salt of lead also showed no change in three months, with the exception of loss of weight.

Effect of Alcohol.

The animals which had shown no signs of lead poisoning at the end of eight months beyond the diminution in weight, were then given alcohol, in the form of a cheap port wine, with their food, which they took greedily. The animals fed upon low solubility glaze and high solubility glaze remained well nine months later, whereas the animals fed upon frit and white lead, showed symptoms of poisoning: the frit animal had fits at the end of the seventh, eighth, and ninth months subsequent to starting the alcohol, recovering entirely from each fit and exhibiting no symptoms the next day; the white lead cat died in a month with acute encephalopathy (fits).

A further animal fed on white lead and alcohol from the start, also died in one month in an acute fit.

The control animal fed upon white lead all the time remains alive.

There is therefore evidence that the addition of alcohol to the animals' diet

(*a*) Increases the susceptibility to lead poisoning when administered from the beginning with a lead compound.
(*b*) Hastens or determines the onset of symptoms of lead poisoning in an animal that has been subject to an infection by lead.
(*c*) The poisonousness of the compounds showed fritted lead to be less poisonous than white lead.

It is important in this case to call to mind the fact that in the lead industries hard drinkers are the persons most likely to suffer from lead encephalopathy.

Breathing Experiments.

Number of animals experimented with—14.

Method.—In the breathing experiments the cage was so arranged that four animals could be experimented upon at once under identical conditions, two being subjected to the test of low solubility glaze, and two to the raw lead glaze. The quantity of lead dust circulating in the cage air varied from ·001 to ·003 gramme per litre of air in the case of both the low solubility glaze and the raw lead glaze.

Compounds Used.—In the breathing experiments the compounds used were the high solubility or raw lead glaze, and the low solubility glaze containing lead frit.

Result of Experiments.

In the previous experiments in which white lead was used as being a common constituent of a raw lead glaze, the time-rate of poisoning was determined to be about $1\frac{1}{2}$ months with exposures of one hour three times a week. It was found that the animals exposed to the breathing* of low solubility glaze developed acute pneumonia fifteen to twenty days after commencing the experiments, whereas the animals exposed to the raw lead glaze developed a mild degree of bronchitis, from which they recovered. The frequent exposures to the particles of the low solubility glaze appeared to produce more irritation in the lung than did the raw lead glaze. The animals exposed to the raw lead glaze were the first to show signs of lead poisoning, and ultimately succumbed to acute lead poisoning. The animals exposed to the low solubility glaze showed symptoms of lead poisoning a month later than the animals which were exposed to raw lead glaze, but they eventually became poisoned, and the post mortem appearances were those which I have shown to be definitely associated with lead infection.

Comparison with Feeding Experiments.—A contrast of the feeding and breathing experiments showed that the animals were much more susceptible to the effects of lead when it was inhaled in the form of dust than when the same dust was swallowed even in a finely divided condition, and that the exposure to lead-dust-laden air was more deleterious than swallowing a soluble lead compound.

Entrance of Lead Dust into the Body.

As it was found that the effects of lead as dust were more deleterious than lead when swallowed, direct experiment was made to determine if lead dust was found in the stomach after exposure to dust-laden air.

Method.—Animals were exposed to breathing the air heavily charged with low solubility glaze, raw lead glaze, and white lead. The animals were killed under chloroform directly after exposure to dust-laden air, and immediate examination made of the lung, trachea, œsophagus, and stomach by chemical, microscopical, and micro-chemical means.

Result of Experiments.

Traces of lead were found in the œsophagus and stomach in one animal, whereas a well-marked lead reaction was obtained from the trachea, the bronchi, and even in the bronchioles of the lung with all the animals, showing that lead dust had definitely penetrated to the lung, and that little or no lead had been swallowed. As the animals always breathed through their noses, any physiological mechanism for the prevention of the entrance of dust to the lung would be in operation.

Microscopical Methods.—Sections were made of the lung and stomach and stained by various methods (chromic acid, iodine, H_2S, &c.) for the detection of lead. Some difficulty was experienced in differentiating the carbon particles normally in the lung, from the lead particles, as both are dark in colour when viewed by transmitted light, even when the lead is converted into a chromate. By means, however, of a vertical illuminator with a strong beam of parallel light, and also by direct surface illumination, lead particles, yellow in colour (chromate) were definitely found in the alveoli of the lung, in the alveolar cells, and penetrating through the walls of the lung into the blood vessels and lymphatics beyond. Examination with polarized light was also resorted to in differentiating the crystalline particles of lead frit.

Conclusions Deduced.

The conclusion drawn from these experiments therefore is that lead dust gains access to the body through the medium of the lung with comparative ease.

Additional Experiments.

A further experiment bearing on the absorption of lead by the lung may be cited.

Phagocytosis of white lead or fritted lead particles readily takes place when an emulsion of normal blood and white lead is made, and the movements of the polymorphonuclear leucocytes watched on the warm stage of the microscope. The smaller white lead

* Control animals inoculated with frit or glaze did not develop pneumonia or bronchitis, but only gave symptoms of plumbism.

particles gradually disappear in the bodies of the leucocytes and by appropriate micro-chemical means I have demonstrated the presence of lead in solution in the leucocytes.

This experiment has a direct bearing upon the absorption of lead particles in the lung as the alveolar cells are amœboid.

With regard to the difference between the two glazes, the low solubility glaze contains fritted lead and the raw lead glaze white lead, and I therefore measured finely ground specimens of each under the microscope and noted that the particles of the frit were on an average ten times as large as those of the white lead (the white lead particles averaged 1-35000 in. and the frit 1-3500 for the smallest particles); and further, when two samples of an equal portion of the two compounds were taken and shaken up in a double vessel having parallel glass sides, the white lead dust remained visible in a beam of parallel light for some time after the compartment containing the fritted lead showed that the dust had settled.

The Absorption or Osmosis of Lead Through Animal Membranes.

The next step in the enquiry was to determine the relative absorption of various compounds of lead, and the permeability of animal membranes, as the lung appeared to be at any rate one of the chief sources of infection.

Direct Experiment.

A direct experiment was made upon an anæsthetised animal. Lead dust was blown into the lung whilst artificial respiration was performed, the animal being deeply under the influence of chloroform. The blood returning from the lung was collected during the experiments, and on examination afterwards was found to contain traces of lead, but it was impossible to estimate the quantity as no reliable method exists for the estimation of small quantities of lead in the blood.

Further Experiments.

Further experiments were performed by means of dialysing low solubility glaze and high solubility glaze in an albuminous solution.

Method.—A low solubility glaze and a high solubility glaze were thoroughly shaken up with a solution of egg albumen 10 per cent. in distilled water. The resulting mixture was filtered, and the residue dialysed in collodion tubes until the water in the outer vessel showed no trace of darkening with H_2S, hydrofluoric acid being used to liberate the lead in the case of the low solubility glaze. CO_2 was then passed through the inner vessel for twenty minutes, and the water in the outer vessel again examined, when it was found to give a well marked coloration with sulphuretted hydrogen, lead being present.

Inoculation Experiments.

Number of animals experimented with—15.

The simplest method of determining the absorption of lead glazes is by the inoculation of animals, for by this means definite quantities of lead may be introduced and the effects watched.

Explanatory Note on Necessity for the Use of Inoculation Experiments in the present Enquiry.—The performance of inoculation experiments upon animals in conjunction with the experiments directly copying industrial conditions is essential in order to establish the rate of poisoning and the special effect of each compound under experiment. A standard is thus obtained of the dose of each lead compound which is the minimum quantity producing symptoms of poisoning in the class of animal under experiment. Secondly, the distinctive and peculiar symptoms produced by the poison and the body tissues first attacked can be determined with certainty, a question of extreme importance when compound glazes are used containing several constituents. Thus, if an animal which breathed air full of glaze dust exhibited the same symptoms as those shown by an animal injected with a pure lead compound, the symptoms in the two cases are attributable to the same cause, *i.e.* the lead, whereas when other symptoms occurred as in the animals breathing low solubility glaze, *e.g.* pneumonia, the symptom was occasioned not by the lead but by the other constituents of the glaze and the physical condition of the particles. Again, the poisonous effect of a substance is the same be it swallowed or injected, *e.g.* strychnine, morphia, provided no local corrosive action is produced, which is easily guarded against in the case of lead compounds. In determining the absorption through animal membranes, or by the body fluids such as occurs in industrial lead poisoning *viâ* the lung or the stomach, inoculation of a portion of the same compound into another or control animal gives valuable confirmatory evidence of the action of the body fluids or membranes in dissolving or allowing the given compound to become absorbed, for if the compound be absorbed from the peritoneal cavity and causes poisoning, and it is also shown that lead dust is present in the lung of the animal in the breathing experiment and that it had symptoms of lead poisoning, it must follow by analogy that the lead is absorbed from the lung. Again, when a symptom such as colic is produced by breathing lead dust, it might be argued that the lead was really swallowed and hence the colic, but as colic is produced by inoculating the lead compound under the skin, it is at once evident that the action of the lead is not upon the intestinal walls from the inside, but a general effect caused by the poisoning of quite other structures than the intestinal wall alone, and that lung absorption would be sufficient to explain the symptoms. The chemical detection of lead in the animal body is extremely difficult, and the dose producing poisoning is frequently too small to allow of chemical investigation, thus one thirty-thousandth of the body weight of an animal (cat) has produced death from lead poisoning. It is only therefore possible to compare the symptoms produced in an animal suspected of poisoning by lead with the symptoms shown by an animal that is known to be poisoned by lead; hence properly devised absorption (inoculation) experiments provide the means by which a direct control can be kept upon the experiments devised to copy inhalation or digestion of lead compounds under industrial conditions.

Methods.—Two methods were made use of:—

(*a*) Intramuscular or subcutaneous injections.

(*b*) Intraperitoneal injections.

The peritoneal cavity being a closed sac of animal membrane in the living state gives an answer to the absorption of lead through an animal membrane, whilst the intramuscular or subcutaneous injection gives an answer to the question of the solubility of lead glaze in the body fluids.

Dose of Soluble Lead Compound required to produce Acute Lead Poisoning.—I determined first the poisonousness of lead acetate and found ·05 grammes of lead oxide per kilogramme of body weight in the form of lead acetate will produce death in a cat. This compound is the most poisonous of all the compounds with which I have experimented, and may therefore be used as a standard by which to judge the effects of the poisonousness of the glazes and other lead compounds.

Compounds Used.—Raw lead glaze as a rule contains white lead, and low solubility glaze contains fritted lead; therefore the compounds used were:—

Lead frit.

White lead.

Animals inoculated with ·4 grammes of white lead subcutaneously died in one to one and a half months from lead poisoning. ·25 grammes given intraperitoneally produced the same effect. More rapid absorption takes place therefore from the peritoneal cavity than from the subcutaneous tissue.

0·35 grammes of frit subcutaneously produced no objective signs of poisoning, whereas 1·5 grammes of frit produced fits in three months, but did not result in death to the animal. ·5 grammes of frit inoculated intraperitoneally produced fits and the death of the animal in one and a half months. Therefore it appears that with lead frit also absorption through a definite animal membrane, such as the peritoneum, is more rapid than through cellular tissue as in the case of subcutaneous inoculations. Therefore the peritoneal inoculation, that is to say, absorption through animal membrane, takes place more rapidly than does a subcutaneous inoculation.

Washed Frits.—The toxic effect of fritted lead was not expected. From a consideration of the preparation of fritted lead, and of the various formulæ ascribed to lead silicate generally, it appeared that the lead and silica present were not all in combination, but that the lead silicate might be regarded as a eutectic in which both silica and lead oxide are

dissolved. It would follow, therefore, that the lead so held "in solid solution" might be soluble, and, further, that such lead might be dissolved out perhaps by water. If such solution did take place in water it is probable that this would represent such lead as would be dissolved out by the animal tissue or fluids. Further experiments were therefore performed to determine if the toxic effect could be removed by washing. The fritted lead was therefore washed:—

(*a*) In cold distilled water.

(*b*) In hot distilled water.

(*c*) In dilute acetic acid.

The washings with distilled water showed 0·2 per cent. of soluble lead had been extracted, and about 7 per cent. with the acetic acid washing. One gramme of the unwashed frit, one gramme of the cold water washed frit, one gramme of the hot water washed frit, and two grammes of the acetic acid washed frit were inoculated intraperitoneally. Only the unwashed frit animal died, having fits at the end of one and a half months; six months later all the other three animals remained well.

Animals which were inoculated with the washed frit have so far exhibited no signs of poisoning; whereas those animals inoculated with one to two grammes of unwashed frit have always developed symptoms of poisoning. In view of the far-reaching significance of these last experiments, it is essential that they should be still further confirmed, and at the present time I have several animals under experiment. These experiments open up a possibility of removing the traces of lead which exist in a physiologically soluble form in the low solubility glazes by a simple process of washing the fritted lead well in water and running off the supernatant fluid, and it seems probable that by this means the chief deleterious constituents present in fritted lead glass could be eliminated. To confirm these experiments it is essential that a further series of inhalation experiments should be undertaken.

A number of other experiments were also performed of a similar nature with variations in quantity of the frit used, with similar results. It would appear therefore that washing even with cold distilled water removes a certain percentage of what may be termed poisonous lead so far as the animal body is concerned, and on washing with hot water the poisonous lead probably dissolves still further.

General Conclusions Derived from Feeding, Breathing, and Inoculating Experiments.

Fritted lead is considerably less harmful than is raw lead (white lead); at the same time, poisoning can take place through the agency of fritted lead. That poisoning by fritted lead takes place at least twice as slowly, if not more, and that the effects when produced are not so severe or rapid in onset, nor so fatal, as with more soluble compounds, such as acetate of lead or white lead. That fritted lead in the form of low solubility glaze may prove an irritant to the lung when breathed in considerable quantities, and that the glazes of either low solubility or raw lead are both absorbed by the animal body, but most rapidly through an animal membrane such as the peritoneum. That lead dust does actually penetrate into the lung and may be found in the ultimate cells of the lung, and is itself absorbed as Armit has shown nickel carbonyl to be absorbed in cases of poisoning by means of nickel.

Additional Experiment on Absorption.

A further direct method of experiment has been devised and promises to give an answer to the question of intestinal absorption of lead compounds. Under chloroform anæsthesia a loop of intestine was isolated and clamped off, the vein returning blood from the loop was separated. A solution of dilute lead chloride was run into the loop of intestine with a hypodermic syringe. The vein was then cut and the blood dripping from it collected. The experiment lasted an hour, during which time the quantity of blood obtained was 75 cc. The animal was under the influence of deep chloroform anæsthesia during the whole of the experiment and was killed at its termination without having regained consciousness. The blood was dried, incinerated, and tested for the presence of lead, which was found to be present. Absorption of lead chloride therefore takes place in the intestine.

Digestion Experiments.

I have already referred to the entrance of lead by means of the lung and the stomach. It is well known that lead poisoning occurs from time to time in epidemics when the water supply has become infected. But of all the people who are drinking such a contaminated water supply, only a small percentage develop symptoms of lead poisoning, pointing to great variation in susceptibility of individuals towards lead. At first sight this fact might be applied to the susceptibility and immunity exhibited by persons working in dusty atmospheres, but the experiments I have cited point to the lung as a source of infection in industrial poisoning rather than to the stomach, in that animals which breathed lead dust became poisoned, whereas those that swallowed lead dust did not, neither did those which swallowed a soluble compound of lead. Probably a very small percentage of persons poisoned in lead industries are poisoned *viâ* the stomach. Further, it is a well known physiological fact that soluble lead salts such, for instance, as acetate, chloride, or nitrate, precipitate albumen, forming with it a more or less insoluble compound.

Physiological Digestion Experiments.

In addition to the other experiments which have been outlined, a number of physiological experiments have been carried out with a view to determining the solubility of raw lead glaze or white lead and low solubility glaze or fritted lead in artificial digestions resembling as far as possible the normal digestive fluids and digestive cycle of the normal human animal.

Method.—The method adopted for the digestion experiments was to follow out, as far as possible under laboratory conditions, the digestion taking place in the human body. For this purpose an attempt was made to complete the full digestion, making estimations of the lead present in the fluid part of the digestion at various stages of the process.

Extreme difficulty was met with in obtaining reliable concordant figures, which will be referred to later.

The digestions were performed as follows, corresponding as far as possible to a simple yet complete meal. Bread and milk was therefore chosen as containing the various constituents of normal diet and being for general purposes a complete food.

The digestions consisted of:—

Dried bread crumbs	140 grammes
Hydrochloric acid	5·0 cc.
Lactic acid	0·1 cc.
Acetic acid	0·1 cc.
Pepsin	1·2 grammes
Milk to	1200 cc.

To this mixture were added varying quantities of frit or white lead in amounts from one gramme to 15 grammes. The digestion was then maintained at body temperature for two hours with constant agitation. At the end of this time it was divided into two portions; one of these was retained for estimation of the lead in solution in the acid digest, and the other portion was neutralised with sodium carbonate. To the neutralised digest *extract pancreaticum absolutum Benana* was added, and the digestion carried on for another two and a half hours at body temperature. The mass was again removed from the incubator and estimation of the lead in the fluid portion of the digest made.

In other experiments the first or gastric digestion was divided into two portions to commence with, through one of which CO_2 was slowly bubbled during the whole of the time. Each of these digests were again divided into two portions as before, the one being retained for examination, the other being neutralised and pancreatic ferment and sodium carbonate added, CO_2 being bubbled through as in the gastric digest.

Quantities Used and Results.

The following are the general results from 35 digestions:—When one gramme of white lead was used containing ·75 per cent. of lead oxide, the quantity of lead returned as PbO found in the acid digest varied from 2 to 3 per cent., whilst the amount found in the pancreatic digest varied from 4 to 6·5 per cent. of the added lead compound. When the white lead was increased to 12 grammes the quantity returned as PbO in the acid digests varied from 1·5 to 2 per cent. of the amount added.

With one gramme of the frit the amount found in the acid digest was very small, ·15 to ·5 per cent. of the PbO added to the digest; whereas when the amount added was increased to 12 grammes the amount found present in the acid digest varied from 2 to 5 per cent. of the PbO added to the digest.

In every instance the amount of PbO found in both the white lead and frit digestions was larger in the samples through which CO_2 had been passed than in the ones in which CO_2 had not been passed. The normal stomach contents and normal bile and pancreatic juice contain a considerable quantity of CO_2, and it is highly probable from the result of these experiments, and also the result of the diffusion experiments referred to in a previous section, that the action of CO_2 is to render soluble some portion of the lead which has either been taken up as an acid salt and then reprecipitated as an albuminate or peptonate or else exists in a colloid form. In the present stage of experiments it is impossible to make any definite statement upon this point, and the matter is receiving further attention.

It is a fact of common physiological knowledge that the soluble salts of the heavy metals form componnds with albuminous bodies, and are, in fact, constantly used as reagents in their investigation; furthermore, lead albuminate will undergo digestion in the presence of pancreatic juice. The behaviour of the various products formed during digestion and their compounds with lead salts are under investigation, both from the point of view of absorption and precipitation, and will be reported on at a later date.

Difficulty in Estimating Lead present in Gastric and Pancreatic Digestion.

A very large amount of difficulty has been experienced in obtaining reliable figures with regard to the quantity of lead present in the fluid and solid portions of the digestion. The chief sources of difficulty were:—

1. The recombination or precipitation of soluble salts of lead and products of digestion, which, although they may take place entirely in an artificial digestion, it by no means follows that during the process in the body portions of the lead may not be absorbed.

2. In separating the fluid from the solid portions of the digest, recourse must be had to filtration, and in so doing any lead which has been rendered soluble and reprecipitated, perhaps as an albuminate, remains behind on the filter paper, although such compounds may pass through the digestive tract and be absorbed during the later stages of digestion.

3. There was extreme difficulty in applying the colorimetric methods of estimation to albuminous fluids.

4. The presence of traces of iron in practically all foodstuff which has been used for digestion experiments.

Methods of Estimation.

The methods of estimation which have been used are as follows:—

(a) *The Sulphate Method.*—This is extremely unsatisfactory when very small quantities of lead have to be dealt with, and the amount of labour entailed in treating the large number of controls necessary is very great.

(b) *The Colorimetric Method.*—Attempts were made to obtain some colorimetric standard in albuminous fluids containing lead, but owing to the precipitation and the opalescence of the fluids it was found quite impossible to obtain satisfactory results by titrating the digestion fluid direct.

The fluid was therefore dried, incinerated, extracted with dilute nitric acid, dried and re-extracted, evaporated, extracted with amonium acetate, and colorimetric titration tried. Very grave errors were introduced by this method owing to the coloration of the solution by the presence of iron. In the case of the frits particularly the figures of the same batch of digestion varied to at least 20 per cent.

In attempting to estimate the quantity of lead still contained in the undissolved portions of the digestion a large bulk of material had to be dealt with, and a considerable quantity of iron present completely vitiated the results.

(c) *The Molybdate Method.*—This method has given, perhaps, the most reliable results of any of the methods tried, but the exceedingly fine end-point of the reaction makes it also somewhat unreliable.

Post mortem Indications of Lead Poisoning.

Time of Post mortems.—In the case of every animal that has been experimented upon, 40 in all, careful and full post mortem examinations have been made; in the case of many of the animals immediately after death, the animal having been killed by means of anæsthetics when it showed signs of lead poisoning; in other cases where the animal had died of lead poisoning, as soon after death as possible, and always within 24 hours of death.

Scope of Post mortems.—The post mortem examinations have included a minute examination of the brain, spinal cord, stomach, intestine, liver, spleen, pancreas, kidney, muscles, and the nerves. In the majority of cases portions of each of the viscera, nerves, brain, etc., have been submitted to histological examination and certain constant facts have been observed.

Summary of Present Knowledge of Pathology of Lead Poisoning.

Considerable discrepancies exist in the published works on the pathology of lead poisoning. Various observers have stated that the nerve affections found in paralysis following poisoning by lead owe their origin to degeneration of the nerve cells or of the nerve fibres supplying the affected muscles. On the other hand, more acute symptoms, such as colic, have been stated to be due to a vaso-motor spasm of the mesenteric vessels. Burnard, Löwenthal, Wolf, Keil, Boelke, and others have stated that the red blood cells suffer first, and that damage is also produced by degenerative changes in the blood vessels of the liver, spleen, bone marrow, kidneys, the degeneration taking place in the form of chronic thickening of the intima of the smaller blood vessels. Other authors, again, point to affection of the sympathetic nerves of the mesenteric and splanchnic areas as being involved in the poisoning and causing the pain in acute colic.

In cases of chronic lead poisoning, and these are, as a rule, the only ones which come into the hands of the pathologist, degenerative and fibroid changes have been found in the spleen, in the liver, and in the mesentery. Kolle noted that when an animal was injected with lead in the vessels an increased mobility took place at once in the abdominal viscera. Tanquerel describes the affection which generally goes by his name as due to the affection of the peripheral nerves.

In encephalopathy and cerebral forms of lead poisoning, thickening of the membranes and degeneration of the cortical cells have been described.

The findings of most authors point to some affection of the blood system as the one chiefly involved in lead poisoning.

Knowledge Gained by Experiments for the Committee.

The experiments that have been carried on at the instigation of the Committee have brought to light several exceedingly important facts in relation to the action of lead on the animal tissues. These facts may be summed up as follows:—

(*a*) In animals acutely poisoned with lead, capillary hæmorrhages are to be found in the liver, lung, intestine, spleen, cortex of the brain; particularly hæmorrhage under the arachnoid membrane.

(*b*) Microscopical hæmorrhages have been found affecting the nerves supplying muscles which were the subject of paralysis. For instance, in a cat which had paralysis of the hind legs the anterior crural nerve supplying the paralysed muscles was examined microscopically and no nerve degeneration was found, the axis cylinders being perfectly normal, but minute hæmorrhages were found here and there between the nerve bundles, in several cases directly pressing upon the nerve bundles themselves. Also in an animal which had died in a fit after the administration of lead, the dura mater was fonnd to be slightly thickened microscopically, and minute microscopical hæmorrhages were to be found from point to point underneath the arachnoid membrane, and here and there in the substance of the brain cortex the vessels were engorged with blood and leakage had taken place. Microscopical hæmorrhages have also been found in the spinal cord.

(*c*) In all the animals which have had definite symptoms of lead poisoning the large intestine has been found darkly stained, the dark staining being due to lead sulphide. The dark staining commences at the ileo-caecal valve, and is more marked in the upper portion of the large intestine than the lower. The mesenteric glands in the neighbourhood of the appendix and caecum, together with the blood vessels in this region, are engorged with blood, and frequently microscopical hæmorrhages of a petechial nature are found. The whole mesentery, with its plexus of blood vessels

in this particular portion of the abdominal cavity, is in a state of chronic inflammation, suggesting that the excretion of lead is taking place somewhere in the region of the large intestine, absorption taking place in other situations higher up. This staining of the large intestine was seen in animals inoculated with lead subcutaneously and intraperitoneally, in animals which had been fed upon lead for long periods, and animals which had inhaled lead dust during the breathing experiments. It was not, however, found in the case of certain animals which had had large quantities of lead administered to them by means of a tube passed directly into the stomach.

General Appearances of Lead Poisoning.—The general appearances of poisoning by lead which I have observed in the animals experimented upon have been loss of subcutaneous and mesenteric fat associated with general wasting and emaciation, mental irritability followed by stupor, and, in the acute cases, encephalopathy—rarely colic.

Onset of Symptoms.—In men poisoned by lead the symptoms of intoxication usually appear in the following sequence: wasting of subcutaneous fat, colic, muscular wasting and loss of muscular tone and power, encephalopathy (fits), death.

In the poisoned animal the sequence of symptoms was the same and the gradual development of one symptom after another was exactly comparable to the manifestations of poisoning in man.

Microscopical Results.—These microscopical results are of great importance, particularly in the light of the statements that have been made by the observers quoted. It is quite evident that where the affection has lasted for some time, the hæmorrhage being microscopical, it would become obliterated by fibrous tissue, and the pressure sometimes might ultimately cause nerve degeneration. The acute onset of wrist drop in many cases is suggestive of hæmorrhage rather than of any other change.

The fact that these microscopical hæmorrhages are found in all the acutely poisoned animals points to the origin of and explains the various microscopical appearances that have been described by earlier observers. Practically the whole of the symptoms and the whole of the morbid histology to be found in the literature can be supposed to have resulted from primary microscopical hæmorrhage. Further, I think that important deductions with regard to treatment are foreshadowed by the curious specific nature of the action of the drug. It is important also to note that in the case of nickel, tin, bismuth, and some other heavy metals, a similar specific action upon the blood vessels has, I find, been noted somewhat recently by other observers.

Conclusions.

The conclusions which I especially desire to draw from the foregoing report are:—

I. That aerial infection *viâ* the lung is of extreme, and to my mind chief, importance in industrial lead poisoning.

II. That fritted lead is not absolutely innocuous and will produce poisoning under certain conditions, and that the particles of frit apparently cause more local damage to the lung tissue than do the raw lead glazes.

The more deleterious portions of the frit would seem to be removable by appropriate means.

III. That the action of lead is upon the blood vessels, determining minute hæmorrhages, which are one of the most important pathological effects of lead poisoning.

Kenneth Goadby.

APPENDIX XXVI

RECENT EXPERIMENTAL WORK BY W. THOMASON, Esq., F.I.C.

The following is a brief summary of a number of experiments carried out by Mr. Thomason with artificial gastric and other juices. A full account of the experiments, with deductions based upon them, will be found in two papers in the "Transactions of the English Ceramic Society," 1910, vol ix.

In the introduction to his first paper the author states: "At the present time it is the custom to classify glazes by means of a method which in itself conforms to few of the conditions which exists in the human animal. The acidity of the extracting solution is, approximately, that of the gastric juice of the healthy human animal, but the temperature at which the extraction is conducted is not the body temperature, and the HCl used in the extraction admittedly does not fully represent the gastric juice. The time of contact is perhaps a fair statement of the average period which food remains in the stomach, though this period is so variable as to be hardly capable of an exact statement.

In the light of these dissimilarities it is not unreasonable to draw a *prima facie* conclusion that the solubility in the laboratory and in the human system are not comparable, but if we look somewhat more deeply into the matter we shall see that these *prima facie* conclusions receive little further support.

In the first place, if the extraction be continued for twice the prescribed time, or longer, relatively little increase in soluble PbO is obtained.

Secondly, if extraction be continued for half the prescribed period, almost as much lead becomes soluble.

Thirdly, if the strength of the acid be increased from ·25 per cent. to 2·5 per cent. but little extra solubility is obtained."

Particulars are then given of a first series of experiments on the following points:—

(a) *The effect of acids found in gastric juice, other than* HCl, *of the same equivalent strength, upon the same glaze.*

Period of agitation, one hour.
Period of standing in contact with acid, one hour.
Strength of acid equivalent to ·25 % HCl.

Percentage of PbO dissolved by—

Hydrochloric acid	at 15°C, 2·02;	at 37·7°C, 3·66
Acetic	„ „ 1·96;	„ „ 3·27
Lactic	„ „ 2·28;	„ „ 3·53
Mixed acids	„ „ 2·01;	„ „ 3·40

The action of butyric acid which occasionally occurs in the stomach in very minute amounts was not ascertained because of its offensive smell and from the uncertainty as to its presence.

(b) *The effect of pepsin.*

Frit was used in this experiment, and 500 cc. of ·25 % HCl in each case.

(i.) Agitation for one hour and standing for one hour:

Percentage of PbO dissolved at—

15°C. without pepsin	2·35
37·7° „ „	4·54
37·7° with 4 grams pepsin	3·98

(ii.) Two hours' agitation and two hours' standing:

Percentage of PbO dissolved at—

37·7°C. without pepsin	5·76
„ with 4 grams pepsin	5·00
„ with 4 grams pepsin and 17 grams egg albumen	4·55

(c) *The effect of lactic and hydrochloric acids with pepsin at 37·7° C.*

Two hours' agitation and two hours' standing.
500 c.c. of acid used in each case.

Percentage of PbO dissolved by—

·25 % HCl	without pepsin	5·76
·13 % HCl + ·02 % lactic acid	„ „	5·40
·13 % HCl + ·02 % „	with ·5 gram pepsin	5·30

(d) *Experiment with bread and milk to represent carbohydrates, fats and proteids of food.*

Two hours' agitation and two hours' standing at 37·7°C to 40°C.

1 gram frit and ·5 gram pepsin used, and the acidity made equivalent to ·13 % HCl + ·02 lactic acid, in each case.

(i.) With 200 c.c. milk, 300 c.c. weak acid, and 20 grams stale bread. Solution divided into two parts, and examined for lead colorimetrically and gravimetrically.

Percentage of PbO dissolved, estimated—

Ccolorimetrically - - - - - -	5·00
Gravimetrically - - - - - -	5·33
Mean - - - - - - - -	5·13

(ii.) With 500 c.c. weak acid only. Gravimetric estimation only and organic matter destroyed by oxidation with $HCl + KClO_3$.

Percentage of PbO dissolved - - - 5·86

(e) *Pancreatic digestion.*

200 c.c. milk, 300 c.c. water, 20 grams bread, and 1 gram frit digested with 25 c.c. pancreatic extract and ·5 gram Na_2CO_3 for four hours with repeated agitation.

Percentage of PbO dissolved - - - ·40

(f) *Dialysis through a parchment paper membrane (parchment being found to be destroyed in four hours by the pepsin used.*

Dialysing from 25 c.c. $PbCl_2$ solution (equivalent to ·1 gram PbO), with 100 c.c. milk, 150 c.c. dilute acid, 10 grams bread, and ·25 gram pepsin, lead could be identified in the surrounding liquid at the end of 15 minutes, and was very prominent there after four hours.

(g) and (h) *Dialysis experiments with pancreatic extract.*

Portions of the mixture, as in (f), were neutralized with Na_2CO_3 and further treated as follows:—

(g) ·25 gram excess of Na_2CO_3 added + 7 c.c. pancreatic extract.

Two hours' digestion with vellum as membrane gave no lead in exterior liquid, but strong reaction for chloride with $AgNO_3+HNO_3$.

Four hours' digestion with parchment paper as membrane gave no lead in exterior liquid, but very strong reaction for chloride.

(h) Solution rendered alkaline by addition of $NaHCO_3$ (equivalent to ·25 grams Na_2CO_3) + 7 c.c. pancreatic extract.

Four hours' digestion gave no lead in exterior solution, but very strong reaction for chloride.

The second of Mr. Thomason's papers deals with the effect of food-stuffs of different kinds in varying proportions to the acid and lead present, most of the experiments being carried out on raw white lead, or glazes compounded with it. All the digestions recorded in this paper were carried on for two hours, viz.: one hour agitation and one hour standing.

A. *With a low lead content, but still very high from an industrial point of view, and a large amount of acid and not very much food.*

200 c.c. milk, 300 c.c. weak HCl, 20 grams bread, ·5 grams pepsin, acidity ·25 per cent. HCl, in each case.

(i) With ·5 gram raw lead earthenware glaze—

PbO dissolved (actual amount) - -	·088 gram
„ „ expressed as percentage of glaze taken - - -	17·6 %
„ „ expresses as percentage of Pbo present - -	94·0 %

(ii) With ·5 gram fritted earthenware glaze—

PbO dissolved (actual amount) - -	·018 gram
„ „ expressed as percentage of glaze taken - - -	3·6 %
„ „ expressed as percentage of PbO present - - -	18·5 %

The solubilities of the glazes used in this experiment, determined according to the Home Office rule, were 17·0 and 3·2 respectively.

B. *With a considerably larger amount of the glazes and the acidity reduced to* ·15 *per cent.* HCl, *the food being maintained at the same relative amount as before.*

100 c.c. milk, 150 c.c. weak HCl, 10 grams bread, ·25 gram pepsin, acidity ·15 per cent. HCl, in each case.

(i) With 1·25 grams raw lead glaze—

PbO dissolved (actual amount) - -	·028 gram
„ „ expressed as percentage of glaze taken - - -	2·24 %
„ „ expressed as percentage of PbO present - - -	12·0 %

(ii) With 1·25 grams fritted lead glaze—

PbO dissolved (actual amount) - -	·016 gram
„ „ expressed as percentage of glaze taken - - -	1·28 %
„ „ expressed as percentage of PbO present - - -	6·6 %

(iii) With ·25 gram fritted lead glaze—

PbO dissolved (actual amount) - -	·008 gram
„ „ expressed as percentage of glaze taken - - -	3·2 %
„ „ expressed as percentage of PbO present - - -	16·5 %

C. *Experiments showing white lead by itself to be considerably less soluble than the same amount contained in a glaze.*

100 c.c. milk, 150 c.c. weak acid, 10 grams bread, ·25 gram pepsin, acidity ·15 % HCl, in each case.

(i.) With ·05 gram Lambeth white lead:

PbO dissolved—

(Actual amount) - - - - -	·024 gram
Expressed as percentage of white lead taken - - - -	48 %
Expressed as percentage of PbO present - - - - -	56 %

(ii.) With ·05 gram Staffordshire white lead: identical results identical with C (i.) above.

(iii.) With ·25 gram raw lead earthenware glaze, practically equivalent in PbO to ·05 gram white lead:

PbO dissolved—

(Actual amount) - - - - -	·036 gram
Expressed as percentage of glaze taken - - - - -	14·4 %
Expressed as percentage of PbO present - - - - -	77·0 %

D. *The effect of varying the amount of white lead, keeping food and acid constant.*

100 c.c. milk, 150 c.c. weak acid, 10 grams bread, ·25 gram pepsin, acidity ·15 % HCl, in each case.

(i.) With ·05 gram white lead: as C (i.) above.

(ii.) With 1 gram white lead.

PbO dissolved—

(Actual amount) - - - - -	·051 gram
Expressed as percentage of white lead taken - - - -	5·1 %
Expressed as percentage of PbO present - - - - -	6·0 %

iii.) With 1·5 gram white lead:

PbO dissolved—

(Actual amount) - - - - -	·070 gram
Expressed as percentage of white lead taken - - - -	4·66 %
Expressed as percentage of PbO present - - - - -	5·4 %

E. *The effect of increasing the acidity of the solution, keeping food and lead constant.*

100 c.c. milk, 150 c.c. weak acid, 10 grams bread, ·25 grams pepsin, 1 gram white lead, in each case.

	Acidity ·15 % HCl.	·25 % HCl.
PbO dissolved—		
(Actual amount) - -	·05 gram	·5 gram
Expressed as percentage of white lead taken -	5 %	50 %
Expressed as percentage of PbO present - -	5·8 %	58 %

F. *The effect of varying the amount of food-stuffs, keeping acid and lead constant.*

1 gram white lead; ·25 gram pepsin; acidity ·15 % HCl, in each case.

(i.) With 250 c.c. milk and 20 grams bread:

PbO dissolved—

(Actual amount) - - - - -	·010 gram
Expressed as percentage of white lead taken - - - -	1·0 %
Expressed as percentage of PbO present - - - - -	1·16 %

(ii.) With 100 c.c. milk, 150 c.c. water and 10 grams bread:

PbO dissolved—

(Actual amount) - - - - -	0·40 gram
Expressed as percentage of white lead taken - - - -	4·0 %
Expressed as percentage of PbO present - - - - -	4·6 %

(iii.) With 50 c.c. milk, 200 c.c. water, and 5 grams bread:
PbO dissolved—
(Actual amount) - - - - - ·286 gram
Expressed as percentage of white lead taken - - - - - 28·6 %
Expressed as percentage of white lead taken - - - - - 33·3 %

G. *Experiments showing the effect of food to be a function of the proteid constituents.*

10 grams bread, ·25 gram pepsin, 1 gram white lead, acidity, ·15% HCl, in each case.

(i.) With 100 c.c. milk and 150 c.c. weak acid:
PbO dissolved—
(Actual amount) - - - - - ·070 gram
Expressed as percentage of white lead taken - - - - - 7.0 %
Expressed as percentage of PbO present - - - - - 8·2 %

(ii.) With 100 c.c. separated milk and 150 c.c. weak acid: results identical with G (i.) above.

(iii.) With no milk and 250 c.c. weak acid:
PbO dissolved—
(Actual amount) - - - - - ·800 gram
Expressed as percentage of white lead taken - - - - - 80 %
Expressed as percentage of PbO present - - - - - 93 %

H. *Experiments showing that the precipitating proteids are mainly those originally present in the milk and not the products of digestion.*

100 c.c. milk, 100 c.c. weak acid, 10 grams bread, ·25 gram pepsin, acidity ·15 % HCl in each case.

(i.) 50 c.c. of $PbCl_2$ solution (equivalent to ·2 gram PbO) digested with the above for 2 hours as before, gave PbO in filtrate ·037 gram, *i.e.* 18·5 % of the amount present.

(ii.) Digestion for 2 hours, subsequent addition of 50 c.c. $PbCl_2$, solution, and further digestion, gave PbO in filtrate, ·080 gram, *i.e.* 40 % of the amount present.

J. *The effect of alcohol.*

100 c.c. milk, 10 grams bread, ·25 gram pepsin. 1 gram white lead, acidity ·15 % HCl, in each case.

(i.) With 150 c.c. weak acid:
PbO dissolved—
(Actual amount) - - - - - ·030 gram
Expressed as percentage of white lead taken- - - - - 3·0 %
Expressed as percentage of PbO present - - - - - 3·5 %

(ii.) With 130 c.c. weak acid and 20 c.c. rectified spirit:
PbO dissolved—
(Actual amount) - - - - - ·020 gram
Expressed as percentage of white lead taken- - - - - 2·0 %
Expressed as percentage of PbO present - - - - - 2·3 %

K. *Comparison of different kinds of food.*

10 grams bread, ·25 gram pepsin, 1 gram white lead, acidity ·15 % HCl, in each case.

(i.) With 100 c.c. milk, and 150 c.c. weak acid:
PbO dissolved—
(Actual amount) - - - - - ·060 gram
Expressed as percentage of white lead taken - - - - - 6·0 %
Expressed as percentage of PbO present - - - - - 7·2 %

(ii.) With 250 c.c. weak acid, containing 30 grams egg albumen:
PbO dissolved—
(Actual amount) - - - - - ·700 gram
Expressed as percentage of white lead taken- - - - - 70 %
Expressed as percentage of PbO present - - - - - 82 %

(iii.) With 250 c.c. weak acid and 50 grams mutton:
PbO dissolved—
(Actual amount) - - - - - ·002 gram
Expressed as percentage of white lead taken - - - - - ·2 %
Expressed as percentage of PbO present - - - - - ·23 %

L. *The effect of varying quantities of mutton.*

250 c.c. weak acid, 10 grams bread, ·25 gram pepsin, 1 gram white lead, acidity ·15 % HCl, in each case.

Amount of mutton	50	33	22	11 grams
PbO dissolved—				
(Actual amount)	·002	·300	·500	·700 gram
Expressed as percentage of white lead taken	% ·20	% 30	% 50	% 70
Expressed as percentage of PbO present	·23	35	58	82

M. *The effect of varying quantities of beef.*

250 c.c. weak acid, 10 grams bread, ·25 gram pepsin, 1 gram white lead, acidity ·15 % HCl, in each case.

Amount of beef	50	33	22	11 grams
PbO dissolved—				
(Actual amount)	·002	·15	·40	·60 gram
Expressed as percentage of white lead taken	% ·20	% 15	% 40	% 60
Expressed as percentage of PbO present	·23	17·5	46	70

N. *The effect of fish, cooked and raw.*

250 c.c. weak acid, 10 grams bread, ·25 gram pepsin, 1 gram white lead, acidity ·15 % HCl, in each case.

70 grams of plaice:	cooked.	raw.
PbO dissolved—		
(Actual amount)	·002	·0012 gram
Expressed as percentage of white lead taken	·20 %	·12 %
Expressed as percentage of PbO present	·23 %	·14 %

O. *Solvent action of an excess of CO_2 on lead compounds suspended in water.*

250 c.c. water, maintained at 37° to 40°C., in each case.

(i.) With 1 gram white lead, and a stream of CO_2 passed continuously for two hours—
PbO dissolved—
(Actual amount) - - - - ·0008 gram
Expressed as percentage of PbO present - - - - - - ·09 %

(ii.) With ·25 gram raw lead earthenware glaze, and a stream of CO_2 passed continuously for six hours—
PbO dissolved—
(Actual amount) - - - - ·00066 gram
Expressed as percentage of PbO present - - - - - 1·5 %

(iii.) With 30 grams white lead, and a stream of CO_2 passed continuously for 1 week:
PbO dissolved—
(Actual amount) - - - - ·00066 gram
Expressed as percentage of PbO present - - - - - ·002 %

APPENDIX XXVII.

REPORT of an Inquiry into the health of Lathe-treaders, by Miss ANDERSON, H.M. Principal Lady Inspector of Factories.

Lathe-treaders: Unmarried.

Out of 100 lathe-treaders interviewed in 28 factories 45 were married. Out of the 45 only 12 were young persons under 18 years at the time of the interview but 38 had begun lathe treading as *young persons.* Four young persons began at 13 years of age; 10 began at 14 years of age; 10 began at 15 years of age; 9 began at 16 years of age; 5 began at 17 years.

The duration of employment in lathe treading of those who *began at* 13 *years of age* had been respectively 12 years, 6 years, 2½ years, 9 years. The duration of employment of those who *began at* 14 *years of age* had been respectively 4 years, 10 years, 7 years, 6 years, 11 years, 3 years, 3 years, 9 years, 6 months, 10 years.

Only one unmarried worker stated that her health was less good at the time of questioning than when she began lathe treading. She began at 17 years of age, and had been lathe treading for 8 years; her right hip was slightly lower than her left, and her shoulder blades slightly prominent.

In all other cases where any appearance of delicacy or pallor was noted (7 cases) or functional trouble admitted—(2 cases in all out of the 45)—it was stated that there had been no change for the worse since beginning lathe treading. In 10 cases the inspector notes that the lathe-treader is strong or healthy looking or well developed, and the ages of commencing in these ranged from 13 years to 16 years.

Thus no evidence was obtained that tended to show any ill-effect as regards health for young workers in this process. A good many said that they felt slight stiffness or fatigue at night during the first week or few weeks at lathe treading, but that this fatigue was not felt after a night's rest.

COPY of Report to Miss ANDERSON, on Married Women's Employment.

Lathe-treaders.

Appended are the Tables we were instructed by you to make for the Committee at present enquiring into the conditions of employment in the manufacture of china and earthenware.

If from such small numbers, deductions may be drawn, the summary of the statistics seem to show:—

(*a*) That lathe-treaders have more children than the married women employed in other (non-lead) processes in the same factories.

(*b*) That the mortality among the children of lathe-treaders (mainly infants under 12 months) is somewhat higher than that of the other married women mentioned above. (In this connection it should be noted that these figures are largely due to three specially bad cases among lathe-treaders.)

(*c*) That although the difference in the mortality of the children of lathe-treaders and of the other women mentioned above is not specially noticeable, the total is high, and may indicate a higher death rate of the children of mothers industrially employed than of mothers not so occupied.

We have seen the Longton lady health visitor, who visits under the Notification of Births Act, and also three midwives, who attend women of the class to whom our enquiry relates. They were generally of opinion that work during pregnancy was not harmful, either to mother or child, but certain of them thought it would be desirable for the sake of the child that there should be prohibition of employment after confinement for a longer period than one month. A suggested period of prohibition was three months. While neither the health visitor or the midwives could give us any special information bearing on the children of lathe-treaders, there seemed to be an opinion that the mortality among the infants of china scourers was higher than that of women employed in other non-lead processes, and also that such china scouring mothers suffered more than others, and that their children were more weakly.

1908.

M. M. VINES.
E. J. SLOCOCK.

SUMMARY.

Number of Factories - - - - - - -	28
Number of Lathe-treaders interviewed - -	100
Of these were:	
(a) Married - - - - - -	55
(b) Unmarried - - - - -	45

Comparison of families of 50 married lathe-treaders, and 50 non-lathe-treaders.

Of *50 married Lathe-treaders* interviewed:

(a) Total number of children - - -	182
(b) „ „ „ living children -	99
(c) „ „ „ still births - -	2
(d) „ „ „ miscarriages - -	3

The average number of children per mother:
(a) born 3·66
(b) living 1·98

Of *50 Non-Lathe-treaders* interviewed:

(a) Total number of children - - -	154
(b) „ „ „ living children -	101
(c) „ „ „ still births - -	3
(d) „ „ „ miscarriages - -	5

The average number of children per mother:
(a) born 3·08
(b) living 2·02

APPENDIX XXVIII.

Suspensions of China-scourers.

Table compiled from Home Office records.

Year.	Works.	Examinations.		Suspensions.			No. of workers certified as fit to resume work after suspension.
		Male Young Persons.	Women.	Males.	Females	Total.	
1900	78	25	3,264	—	1	1 (young person)	1
1901	83	—	3,321	—	4	4 (adults)	2
1902	81	16	3,882	—	3	3 (1 adult, 2 young persons)	—
1903	79	—	3,890	—	1	1 (adult)	1
1904	72	39	3,891	—	—	—	—
1905	72	34	4,064	—	2	2 (adults)	1
1906	74	18	4,683	—	—	—	—
1907	71	15	4,790	—	—	—	—
1908	—	11	3,769	—	2	2 adults)	—

APPENDIX XXIX.

Particulars regarding Age and Health of China-scourers, supplied by Certifying Surgeons (July, 1908).

	Number examined.		Number unsatisfactory owing to cough, throat trouble, &c.
Examined by Dr. Arlidge, Certifying Surgeon for Stoke, Fenton and Longton—			
Ages 15 to 25	147	......	4
" 25 " 35	92	......	5
" 35 " 45	23	......	2
" 45 " 55	14	......	—
" 55 " 65	3	......	—
" over 65	—	......	—
Total	279	......	11
Examined by Dr. Folker, Certifying Surgeon for Hanley— All ages	25	......	—
Examined by Dr. King Alcock, Certifying Surgeon for Burslem— All ages	4	......	—
Total	308	......	11

APPENDIX XXX.

DEATH-RATES AMONG CHINA-SCOURERS as compared with General Female Population in Longton.

Tables compiled by Miss ANDERSON, H.M. Principal Lady Inspector of Factories.

TABLE A.—Years 1896–8.

Female population in Longton (age period 15 to 70 years), taken at census of 1891 = 10,561.

Number of China-scourers in Longton (age period 15 to 70 years), return of 1898 = 160.

Number of *Deaths* from Respiratory Disease and Phthisis.			Total *death-rate per 1,000* per annum.		
Date.	Among total population (as given above).	Among China-scourers.	Date.	Among total population (as given above).	Among China-scourers.
(1.)	(2.)	(3.)	*(4.)*	(5.)	(6.)
1896	45	12	*1896*	4·26	75·00
1897	49	11	*1897*	4·64	68·75
1898 (January to June.)	29	6	*1898*	5·49	75·00

TABLE B.—Years 1906–8.

FEMALE population in Longton (age period 15 to 70 years), taken at census of 1901 = 11,772.

Number of China-scourers in Longton (age period 15 to 70 years), return of 1907 = 244.*

Number of *Deaths* from Respiratory Disease and Phthisis.				Total *death-rate per 1,000* per annum.			
Date.	Among total population (as given above).	Among China-scourers and Biscuit Emptiers.		Date.	Among total population (as given above).	Among China-scourers and Biscuit Emptiers.	
(1.)	(2.)	(3.)		*(4.)*	(5.)	(6.)	
		Scourers.	*Emptiers.*			*Scourers only.*	*Scourers and Emptiers.*
1906	54	6 +	3	*1906*	4·59	24·59	or 36·88
1907	60	7 +	1	*1907*	5·10	28·69	or 32·79
1908 January (to June.)	33	5 +	—	*1908*	5·61	40·98	

* NOTE.—It is not certain whether this number, 244, includes biscuit emptiers or not; the death-rates have therefore been calculated on both assumptions separately.

APPENDIX XXXI.

Particulars concerning Health, etc., of China-scourers (Longton), 1907–8. Collated by Miss Anderson, Miss Vines, and Miss Slocock. H.M. Lady Inspectors of Factories.

No.	Scourers shown in Health Register. 1907.	Ages.	1908.	Ages.	Health.	Method of Scouring.	Condition of Exhaust.	Light.	Ventilation of Shop.	Mess Room.	Overalls and Head Coverings.	Remarks.
1	(October) 8	18–31	(October) 4	26–32	1907 all G 1908 3 G 1 F	2 Wainford machines. No exhaust under rack.	None	Fair	Good	None, all go home.	Regular	
2	7	16–51	5	17–29	1907 5 G 2 F 1908 4 G 1 F	3 jiggers, exhaust and hood. Hand brushing.	Good. No exhaust	Good	Good	Scolloping room.	Regular	2 emptiers, not included, casual.
3	3	26–47	3	26–47	1907 2 G 1 F 1908 2 G 1 F	2 jiggers, exhaust in bench. No hood.	Bad. Improvement promised.	Good	Good	All go home, warehouse if they stay.	Regular	
4	2 1 absent.	25–28	3	25–28	1907 1 G 1 F 1908 2 G 1 F	2 jiggers, exhaust in bench. No hood.	Good	Good	Good	All go home	Regular	Casual workers sometimes.
5	6	15–30	6	15–35	1907 5 G 1 F 1908 6 G	3 sand-blast machines, Ainsley's patent, 2 for hollow-ware, 1 for flat ware. 3 jiggers, hood and exhaust.	Good	Fair	Good	All go home	Regular	Register showed improved health since machines introduced.
6	2	—	1	23	1907 1 G 1 F 1908 1 G	1 Wainford machine - - -	Good to machine	Good	Good	—	Regular	Workers much more healthy.
7	2 1	1 over 40 2 under 40	2	Under 40	1907 2 G 1 F 1908 1 G 1 F cold	1 Wainford machine. No exhaust to stillage.	None	Fair	Good	Mess room	Regular	
8	6	Under 40	6	Under 40	1907 4 G 2 F 1908 5 G 1 F	6 jiggers and 3 exhaust. Fine brush. Glass screens in front of hoods.	Not tested	Fair	Good	Biscuit warehouse.	Not seen	
9	3	Under 40	3	Under 40	1907 3 G 1908 3 G	1 jigger, no hood. 1 jigger, small hood. 3 fine brushers, 1 only with exhaust. To introduce machine.	Not tested	Good	Good	All go home	Dirty	
10	5	16–44	6	17–44	1907 5 G 1908 5 G 1 F	3 jiggers - - - - -	Appeared fair, not tested.	Bad	Good	Biscuit warehouse.	Regular	
11	3	19–42	3	18–37	1907 3 G 1908 2 G 1 F	Jiggers and hoods - - -	Not seen	—	—	—	No employment.	
12	3	19–24	3	19–21	1907 3 G 1908 3 G	2 Wainford machines. Fine brush exhaust. No exhaust under rack.	Good	Good	Good	Mess room (warehouse)	Regular	
13	3	20–35	2	22–38	1907 1 F 2 G 1908 2 G	1 Wainford machine. No exhaust under rack.	None	Good	Excellent	All go home	Regular	New scouring shop, clean and good.

APPENDIX XXXI.—*continued.*

No.	Scourers shown in Health Register. 1907.	Ages.	1908.	Ages.	Health.	Method of Scouring.	Condition of Exhaust.	Light.	Ventilation of Shop.	Mess Room.	Overalls and Head Coverings.	Remarks.
14	(October) 3	18–26	(October) 2	19–27	1907 3 G 1908 2 G	1 Wainford machine. Exhaust at bench for fine brushing.	Good	Good	Good	All go home	Regular	
15	6	21–33	5	19–38	1907 2 G 4 F 1908 5 G	1 Wainford machine. No exhaust at rack. Scouring and fine brushing being done without exhaust.	None	Good	Good	Meals in moulding shop.	Regular	
16	3	20–27	3	20–27	1907 2 G 1 F 1908 3 G	3 jiggers (2 brush, 1 sand-paper).	*Bad*	Good	Fair	All go home	Regular.	Machine to be installed at New Year.
17	4	20–35	2	20–22	1907 4 G 1908 2 G	1 Wainford machine. No exhaust at bench. No fine brushing done.	None	Good	Good	All go home	Regular.	Scouring shop appeared dusty, but no work going on.
18	4	20–38	5	21–40	1907 2 G 2 F 1908 1 G 3 F 1 casual	4 jiggers (2 brush, 2 sand-paper), and 1 hood for hand brushing.	Bad. Not kept well cleaned out.	Good	Good	All go home	Regular	
19	4	19–27	6 including emptiers.	25–37	1907 3 G 1 F 1908 4 G 2 F	4 jiggers (2 brush, 2 sand-paper), and 1 hood for hand brushing.	Good	Good	Good	All go home	Regular	
20	3	18–28	3	19–33	1907 3 G 1908 3 G	Jiggers, exhaust at back - -	Fair	Bad	Poor	All go home	Torn	Dilapidated structure.
21	6	19–29	6	20–30	1907 4 G 2 F 1908 2 G 4 F	Jiggers, exhaust at back - -	Good at jigger Bad at fine brushing.	Good	Good	Biscuit warehouse.	Torn	
22	6	16–24	4	15–19	1907 3 G 3 F 1908 4 G	1 Wainford machine. 2 hoods on bench.	Bad	Good	Good	Lavatory & mess room combined.	1 torn	
23	4	17–49	3	36–49	1907 3 G 1 F 1908 3 F	2 Wainford machines. Fine brushing.	Not tested	Good	Good	Printing shop.	Rags	
24	7	17–38	4	18–35	1907 3 G 4 F 1908 2 G 2 F	1 Wainford machine. 1 for cast ware and slops.	Bad	Fair	Good	Lavatory & mess room combined.	Regular	
25	Not open	—	2	—	1908 1 G 1 F	Jiggers and hoods - - -	Good	Good	Fair	All go home	Regular	
26	3	29–44	3	29–48	1907 2 G 1 F 1908 2 G 1 F	3 jiggers and exhaust (1 sand-papering).	Bad	Good	Good	Printing shop.	Regular.	*Very old works.*
27	6	15–38	5	15–40	1907 4 G 2 F 1908 4 G 1 F	2 sand-blasting machines, 1 for flat and 1 for hollow-ware. 2 exhausts on bench. Brushing and sand-papering.	Fair	Not satisfactory.	Fair	Insufficient	Torn	

28	4	18–52	2	19–34	1907 1 G 3 F 1908 1 G 1 F	3 jiggers. No hood or screen -	Bad	Good	Fair	—	Regular
29	5	20–40	7	15–41	1907 5 G 1908 6 G 1 F	Jigger, hood and exhaust, 2 brushes, 2 sand-paper. Hand brushing, small grid -	Fair Not good	Good	Good	All go home	Regular. Head coverings torn.
30	8	18–54	8	19–50	1907 7 G 1 F 1908 7 G 1 F	4 jiggers, hood and exhaust (2 only in use). 4 hand brushers near exhaust -	Good Fair	Good —	Good —	All go home Over room dirty.	Regular
31	3	22–26	3	16–24	1907 2 G 1 F 1908 3 F	3 jiggers (2 brush, 1 sand). Exhaust, wooden trough, half-top board.	Poor	Fair	Good	Yes	Regular
32	15	17–39	7	16–40	1907 12 G 2 F 1 N S 1908 5 G 2 F	4 "Rumblers" (Blair's design). Used pitcher inside enclosed wood case with pipe & exhaust.	Good	Good	Good	Glost warehouse.	Torn by machine racks.
33	11	15–34	13	15–35	1907 7 G 4 F 1908 10 G 3 F	2 *scouring shops.* Jiggers, wooden hoods.	(1) Good, (2) poor	(1) Fair, (2) unsatisfactory.	(1) Fair, (2) unsatisfactory.	Yes	Regular
34	6	18–55	6	19–56	1907 5 G 1 F 1908 6 G	Jiggers, hoods - - - -	Good	Good	Good	—	Regular
35	24	15–35	18	15–44	1907 22 G 2 F 1908 16 G 2 F	4 Wainford machines. No exhaust to rack.	—	Good	Good	?	Regular
36	4	23–59	4	23–59	1907 2 G 2 F 1908 3 G 1 F	2 jiggers (brush and sand-paper) 3 exhausts hand brushing -	Good Bad	Fair	Good	All go home	Regular
37	10	17–41	11	16–40	1907 9 G 1 F 1908 10 G 1 F	2 sand-blast machines. 1 ditto hollow-ware flat. Also jiggers (used occasionally).	Good	Good	Good	Yes	Regular
38	4	22–36	4	28–36	1907 4 G 1908 3 G 1 F	Jiggers and exhaust for brushing.	Good (except at sand-papering).	Good	Fair	All go home	Regular
39	6	15–55	5	18–36	1907 5 G 1 F 1908 4 G 1 F	Jiggers, hoods, etc. Wainford machine being installed.	Appeared good. not tested. To be applied to stillage.	Fair	Fair	Go home	Regular
40	8	18–38	10	17–39	1907 6 G 2 F 1908 7 G 3 F	Jiggers and hoods - - -	Good, except at one end. Fine brushing.	Good	Good	Small mess room.	Regular
41	8	16–50	9	18–40	1907 6 G 2 F 1908 7 G 2 F	2 Wainford machines. No exhaust to rack. Jiggers, used occasionally.	Not tested, not working.	Good	Good	All go home	Only one worker seen.
42	4	19–51	2	41–52	1907 3 G 1 F 1908 1 G 1 F	2 Wainford machines - -	—	Fair	Good	Go home	Regular
43	5	—	4	—	1907 4 G 1 F 1908 3 G 1 F	Jiggers, brush and sand-paper	Not good	Bad	Fair	Go home	Torn
44	2	24–52	5	18–40	1907 1 G 1 F 1908 4 G 1 F	Jiggers, hoods, etc. - - -	Not good	Bad	Fair	Go home	Torn
45	4	21–48	4	21–49	1907 3 G 1 F 1908 3 G 1 F	Jiggers and hoods; will probably put in machine (Wainford's) in January.	Good	Fair	Fair	Pressing shop.	Regular

N.B.—35 special machines are in use in 20 factories. 25 factories are without special machines, but use jiggers and exhaust; of these 25 factories, 12 have poor or bad exhaust, as shown by smoke test at time of visit.

APPENDIX XXXII.

PARTICULARS CONCERNING HEALTH, ETC., OF CHINA-SCOURERS (CERTAIN FIRMS OUTSIDE LONGTON), 1907–8, collected by Miss ANDERSON, H.M. Principal Lady Inspector of Factories.

No.	Scourers. 1907.	Ages.	1908.	Ages.	Health.	Method of Scouring.	Condition of Exhaust.	Light.	Ventilation.	Mess Room.	Overalls and Head-coverings.	REMARKS.
46	(Oct.) 9	18–52	(Oct.) 8	19–35	Oct., 1907.—6 good, 3 fair " 1908.—6 good, 2 fair	2 Wainford machines. No exhaust to rack.	Excellent.	Good.	Good.	Yes.	Regular.	
47	5	—	3	—	" 1907.—1 fair, 4 good " 1908.—All good	1 Wainford machine. Good exhaust to rack. *3 jiggers retained for emergencies.*	Good.	Good.	Good.	Yes.	Regular.	
48	9	—	6	—	" 1907.—2 fair, 7 good " 1908.—2 fair, 4 good	2 Wainford machines. 1 sandblast. No exhaust to rack.	Good. Good.	Good.	Good.	Yes.	Regular.	Formerly 11 scourers at 15s. a week, now 6 at 10s.
49	5	—	5	—	" 1907.—All good " 1908.— "	1 Wainford machine.	Stopped for cleaning out duct; much dust in air. Flat knocking. No exhaust.	Good.	Good.	Go home.	Regular.	
50	5	22–24	6	22–48	" 1907.—All good " 1908.— "	2 jiggers exhaust, but no hood.	Good.	Good.	Good.	1 woman; shares men's mess-room.	Regular.	
51	5	25–39	2	26	" 1907.—1 fair, 4 good " 1908.—All good	1 Wainford machine. 2 jiggers.	Poor.	Good.	Good.	1 woman; shares men's mess-room.	Regular.	
52	3	21–29	3	22–28	" 1907.—3 good " 1908.—3 good	Wainford machine and 1 jigger.	Good.	Good.	Good.	Good.	Good.	
53	12	20–48	7	21–49	" 1907.—10 good, 2 fair " 1908.—7 good	Wainford machine.	Good.	Good.	Good.	Good.	Good.	The machine has been installed since 1907.
54	1	32	2	30	" 1907.—Good " 1908.—1 good, 1 fair	Wainford machine.	Good.	Good.	Good.	Good.	Good.	
55	4	24–45	4	29–46	" 1907.—2 good, 2 fair " 1908.—3 good, 1 fair	Power jiggers.	Good.	Good.	Moderate.	Good.	Good.	
56	7	16–42	5	16–33	" 1907.—5 good, 2 fair " 1908.—4 good, 1 fair	Power jiggers.	Good.	Good.	Good.	Good.	Good.	
57	3	25–35	2	29–36	" 1907.—3 good " 1908.—2 good	Power jiggers.	Good.	Moderate.	Moderate.	Moderate.	Moderate.	

N.B.—10 machines in 8 factories.

APPENDIX XXXIII.

DEATHS FROM PHTHISIS AND DISEASES OF THE RESPIRATORY ORGANS among Workers in the six Pottery Towns in Staffordshire (1900–1902).

Memorandum by Dr. G. REID.

I have prepared the following memorandum from figures specially extracted for this Committee by Mr. C. H. Martin, of the Statistical Department of the General Register Office, with the permission of the Registrar-General.

The figures relate to working males in Burslem, Fenton, Hanley, Longton, Stoke-on-Trent and Tunstall, with an aggregate population at all ages of 208,872, as recorded by the 1901 census. They cover a period of three years which were selected as affording the most reliable information from a statistical point of view, being the last census year and the years immediately preceding and following it.

The following table shows the aggregate occupied male population of the six towns (1901 census) classified under different occupational age groups and multiplied by three for the purpose of calculating the death rates, based upon the deaths recorded and set forth under each group for the three corresponding years:—

AGGREGATE OF SIX POTTERY TOWNS.

OCCUPIED MALES.

	Total 15 years and upwards.	15	20	25	35	45	55	65 years and upwards.
Potters.								
Population × 3	62,436	... 11,118	9,954	17,445	12,078	7,557	3,282	1,002
Deaths from—								
Phthisis	194	... 8	13	35	59	68	11	—
Respiratory diseases	343	... 6	3	19	59	112	99	45
Other causes	489	... 15	19	56	101	118	98	82
All causes	1,026	... 29	35	110	219	298	208	127
Artisans.								
Population × 3	81,642	... 12,951	12,090	20,328	16,083	11,322	6,387	2,481
Deaths from—								
Phthisis	123	... 6	6	24	35	41	11	—
Respiratory diseases	292	... 3	3	24	32	66	85	79
Other causes	693	... 32	38	57	99	125	149	193
All causes	1,108	... 41	47	105	166	232	245	272
All other occupations.								
Population × 3	44,874	... 6,753	6,825	12,114	8,682	5,547	3,471	1,482
Deaths from—								
Phthisis	60	... 1	7	16	21	12	3	—
Respiratory diseases	109	... 1	3	8	17	29	27	24
Other causes	420	... 11	14	46	76	80	86	107
All causes	589	... 13	24	70	114	121	116	131

The following table shows the death rates per 1,000 living at the various age periods worked out on the figures in the previous table:—

AGGREGATE OF SIX POTTERY TOWNS.

	Comparative mortality figure (25—65 years).	15	20	25	35	45	55	65 years and upwards.
Potters.								
Phthisis	318	... 0·72	1·31	2·01	4·88	9·00	3·35	—
Respiratory diseases	637	... 0·54	0·30	1·09	4·88	14·82	30·16	44·91
Other causes	771	... 1·35	1·91	3·21	8·37	15·61	29·87	81·84
All causes	1,726	... 2·61	3·52	6·31	18·13	39·43	63·38	126·75
Artisans.								
Phthisis	144	... 0·46	0·50	1·18	2·18	3·62	1·72	—
Respiratory diseases	286	... 0·23	0·25	1·18	1·99	5·83	13·31	31·84
Other causes	587	... 2·48	3·14	2·81	6·15	11·04	23·33	77·79
All causes	1,017	... 3·17	3·89	5·17	10·32	20·49	38·36	109·63
Other occupied males.								
Phthisis	124	... 0·15	1·03	1·32	2·42	2·16	0·86	—
Respiratory diseases	209	... 0·15	0·44	0·66	1·96	5·23	7·78	16·19
Other causes	730	... 1·63	2·05	3·80	8·75	14·42	24·78	72·20
All causes	1,063	... 1·93	3·52	5·78	13·13	21·81	33·42	88·39

As regards phthisis, it will be noticed that in all the age groups the rates are higher among potters than among artisans or other occupied males, and it will also be seen that the mortality from this disease gradually increases from 15 years onwards until it reaches its maximum in the age group 45–55, after which it rapidly declines.

On the other hand, the mortality from respiratory diseases, which is also much higher among potters than among other workers, and increases rapidly in each successive age group, is most marked at the advanced ages.

By subdividing the figures under a number of age groups and working out rates upon these, the risk of statistical error is increased, but this objection does not hold good to the same extent when the figures are dealt with in the aggregate, as has been done in framing the table which will follow, showing the comparative mortality figures for different workers between the ages 25–65.

Quoting from the Registrar-General's Decennial Supplement, 1891–1900, the reasons for selecting these particular years, namely, the forty years which intervene between the 26th and 66th birthdays, are that they "are far more valuable and more trustworthy than the others; for not only are these the age periods in which the numerical basis is, as a rule, the largest, but they are also the periods in which the influence of occupation is most marked. In the earlier age-periods the effect of occupation is not as yet fully developed; and the last age-period, 65 years of age and upwards, is that which is more especially affected by the disturbing cause previously noted, namely, the retirement from the industry of such men as have become too weakly to follow it."

Occupational statistics, however, must be accepted cautiously for various reasons; for example, many trades require a high standard of physique, and certain workers coming below that standard either do not enter such trades or soon have to take up less laborious work, thus leaving in one trade picked men physically, while the weaklings may predominate in other trades. To what extent such influences are operative in the pottery towns I am not prepared to say, but, on the whole, I think that among the strictly artisan class the figures for the potter are fairly comparable with those for workers in other trades.

AGGREGATE OF SIX POTTERY TOWNS. (1900—1902.)

Comparative mortality figures (25 to 65), all males in England and Wales being taken at 1,000.

	Phthisis.	Respiratory.	Other causes.	All causes.
Potters - - -	318	637	771	1,726
Artisans - - -	144	286	587	1,017
Other occupied males -	124	209	730	1,063
All males, England and Wales - - -	186	174	640	1,000

It will thus be seen that the mortality in the six Pottery towns from phthisis among male potters is more than twice that among other artisans and more than two and a half times that among other occupied males, and as regards respiratory diseases the death rate among male potters is more than twice that among other artisans and more than three times that among other occupied males.

These figures, taken by themselves, do not show the extent of the injury which appears to result from working in the potting trade, and in order to arrive at this I have worked out from the comparative mortality figures, the relative actual number of deaths in the six towns among male potters and artisans respectively, with the following result:—

Annual excess number of deaths from phthisis among male potters over other artisans aged 25—65 years, probably attributable to their occupation - - - - - - - -	33
Annual excess number of deaths from respiratory diseases among male potters over other artisans aged 25—65 years, probably attributable to their occupation - - - - -	67
Total - - - - - -	100

But even these figures do not represent the sum total of the injury, for they relate to male workers only. The records in the death registers do not allow of similar figures being prepared relating to female potters in the six towns because the occupations of females are so seldom given. In the case of Longton, however, the local Registrar of Deaths has been in the habit of entering the occupation of women workers in his death returns, and figures for that borough for the three years, 1900-1902, have been specially abstracted for the purpose of enabling a comparison to be drawn between the male and female potter as regards deaths from phthisis and respiratory diseases.

Of course, it would have been more satisfactory if the figures for the six towns could have been obtained, because the conclusions would have been more reliable had they been based upon larger numbers. As this was not possible, however, I have taken the Longton figures as a basis for arriving at the relative male and female rates for the six towns, and have obtained the proportion of female to male mortality among potters by applying the female death rates at the four age groups, 25-35, 35-45, 45-55, and 55-65, to the number of male potters at the same ages.

By this process I find as regards Longton that the figures work out as follows: The proportionate death rate of female to male potters from phthisis is 0·782 to 1, and the corresponding figures as regards respiratory diseases are 0·321 to 1. According to the Home Office returns the number of female potters in the Potteries is practically the same as male potters (23,901 and 23,565 respectively), and, allowing for the apparent lower mortality among females, the following figures represent the injury resulting to both sexes as gauged by deaths from the two classes of disease:—

	Male.	Female.	Total.
Annual excess number of deaths from phthisis among potters over male artisans aged 25—65 years, probably attributable to occupation - - - - -	33	26	59
Annual excess number of deaths from respiratory diseases among potters over male artisans aged 25—65 years, probably attributable to occupation - - - -	67	22	89
Total - - -			148

Whatever the error due to the method of arriving at these figures may be, it may fairly be concluded that it is in the direction of under-estimating the injury as regards female potters, because it is known that women do not work so long at the trade as men, and the age classification of workers shows that many of them give up the work about the time when the injury, so far as respiratory diseases are concerned, usually manifests itself, and these may subsequently die from such diseases contracted when working as potters, although in the registrar's returns they would not be classified as potters. We may safely infer, therefore, that the total of 148 deaths per annum is an under-estimate of the injury.

If, therefore, as is generally believed, the chief factor in causing this high mortality from lung diseases among potters is dust, very stringent measures should be taken to ensure that all reasonable precautions are adopted in the future to reduce the dust in the atmosphere of pottery works to its smallest possible limits. It must be remembered also that the death records in themselves only partially indicate the injury inflicted, for in most cases deaths from such causes are preceded by years of suffering.

It may be of interest to compare the fatality caused by lead in the six towns in question during the period covered by the above figures, and to enable me to do so Mr. Werner has been good enough to supply me with the needful data.

During the three years 1900–1902, thirteen deaths among both sexes were recorded from lead poisoning in the Staffordshire Potteries, and dividing this number by three to make it comparable with the annual deaths from lung diseases in the same district, the figures stand as follows:—

Annual deaths from lead poisoning among all potters - - - - - - - - - -	4·3
Annual deaths from lung diseases among all potters in excess of deaths from same cause among male artisans - - - - - -	148

In other words, while I have no desire to minimise the gravity of the situation from the point of view of lead poisoning, as gauged by death records, the injury attributable to working in lead appears to be only 2·9 per cent. of that resulting from other causes incidental to the potting trade. Of course, it is quite true that illness as well as death has to be considered, but

in that respect there is, I think, little room for differentiation between the two classes of disease.

It may be well to point out that the 4·3 deaths occurring annually from lead poisoning represent the deaths among the 5,299 lead workers of all ages in the Staffordshire Potteries, whereas the 148 deaths from the two classes of lung diseases have to be considered in relation to the total number of occupied potters, although the deaths relate to the age period 25-65 only, because it is during such age period that the injury as regards lung diseases attributable to occupation is likely to manifest itself.

Geo. Reid.

Stafford.
July 29th, 1909.

Dr. Reid's conclusions, as set forth above, may be summarised thus:—

Nature of industrial illness.	Number of workers exposed to risk.	Average annual deaths attributable to employment.	Annual death rate, per 1000.
Lead poisoning -	5,299	4·3	0·81
Phthisis and respiratory diseases.	about 21,000	148	7·05

APPENDIX XXXIV.

Compensation in Cases of Lung Diseases among Potters.

Memorandum by Dr. G. Reid.

The following Memorandum, which I have prepared at the request of the Chairman of the Committee, must be regarded merely as an expression of my own views concerning an exceedingly difficult question. I have endeavoured to deal with the medical aspect of the question in a way which may assist the Committee in coming to a conclusion as to whether, at this stage, they are in a position to frame specific recommendations regarding a compensation scheme.

It would seem to be an undoubted fact that potters suffer and die in larger numbers from lung diseases than general artisans, and, this being the case, it may reasonably be urged that to the extent to which the excessive incidence of such diseases is attributable to occupation so the workpeople should be compensated.

In considering a scheme of compensation, however, a difficulty presents itself which does not exist in the case of more specific trade diseases, such as lead poisoning. Whereas all cases of lead poisoning among lead workers may be regarded as resulting directly from their occupation, it is different in the case of lung diseases, because, irrespective of occupation, a large number of people suffer and die from such diseases. In other words, among potters who suffer and die from lung diseases, it is impossible to place in one group those who have contracted the disease as a result of their occupation, and in another group those who in any case, irrespective of occupation, would have so suffered or died.

Further, the data at present available only enable us to compare potters as a general class with other artisans in the Potteries; we have no means of differentiating between the various classes of potters according to the incidence of lung diseases in each class, although it is practically certain that they vary greatly in this respect, in fact, in some branches of the potting trade in all probability the workers do not suffer from lung diseases in greater degree than the ordinary artisan.

Again, as bearing upon the question of compensation, this class of disease usually develops very slowly, and the workers may continue their occupation for years without discomfort, although all the time, while exposed to the risk, insidious and progressive impairment of lung tissue goes on until the stage is reached when complete or even partial recovery becomes impossible. No doubt if systematic medical examinations at comparatively long intervals were instituted, symptoms indicative of danger might in many cases be detected in time to save the worker by preventing him from continuing to follow that particular occupation. Here again, however, we are met with the twofold difficulty of determining (*a*) what processes in the potting trade shall be scheduled for periodical medical examinations; and (*b*) how we are to distinguish between those workers who in any case, irrespective of occupation, would have contracted the disease, and those whose occupation has been instrumental in causing it.

Assuming for the moment, however, that we were in a position to schedule the dangerous processes from the point of view of lung diseases, on what basis should a compensation scheme be framed? Having regard to the fact that apart from employment a considerable number of the workers inevitably suffer from lung diseases, it would hardly seem fair to call upon the employer to compensate these, and in the majority of cases, at any rate, it would not be possible to determine which do and which do not suffer as the result of occupation. This being the case, it would seem that insurance on a contributory basis would be the reasonable solution of the difficulty, the employers contributing a sum proportionate to the increased incidence of the disease due to occupation, and the employees the balance, thus providing for compensation in all cases of incapacity or death from lung diseases among workers in scheduled processes, irrespective of whether the disease could or could not be attributed directly to occupation.

Such a scheme as this, however, must be subject to revision from time to time, say every five years, because one must anticipate that, with the introduction of improved preventive measures, lung diseases—the result of occupation—will be greatly reduced if not entirely abolished.

For the reasons indicated, however, it would be impossible to put such a scheme into operation at once. Steps must first be taken to arrive at the present position as regards injury among different classes of workers in order to determine the varying risk, and, consequentially, the sliding scale for contributions to the insurance fund by the employers and employees respectively.

The only practicable method of arriving at this would appear to be by means of a careful and systematic medical examination of the present workers by medical men specially appointed for the purpose and who have had special clinical experience in lung diseases. Having regard to the numbers employed and the high incidence of lung affections among them, as gauged by the death returns, one may reasonably expect that a satisfactory classification might be arrived at by the examination of the present workers. This being achieved, by means of subsequent periodic medical examination by the certifying surgeons (say annually) of the workers in the processes which would then be scheduled, it would be comparatively simple, say at quinquennial intervals, to revise the scale of contributions on the data meanwhile collected.

Of course, the preliminary systematic examination of the workers would be no light undertaking, but when once completed it would not need to be repeated. It is difficult to arrive at what the cost would amount to, but it may be roughly estimated.

If one may conclude that the conditions in the Staffordshire potteries compare generally with those in other potteries throughout the Kingdom, it would probably suffice to examine the Staffordshire potters only, as they constitute about three-fourths of the whole number.

Again, the increased incidence of lung disease among potters, as gauged by the death returns, does not begin to show itself in a very marked degree until the age-period 25 to 35 is reached, after which it becomes more and more pronounced until the age-period of 55 to 65, when the discrepancy in this respect between potters and other artisans rapidly ceases to be apparent.

This being the case, it would probably answer the purpose if the inquiry was confined to male and female workers between the ages of 25 and 65, although it does not follow from this that any compensation scheme which may be framed should be similarly restricted.

As regards male potters in the Staffordshire potteries, the data needful for classifying them according to age were specially supplied by the Registrar-General's staff for the purpose of my inquiry as to the incidence of lung diseases among potters, but in the case of female potters precisely similar information is not obtainable. In the Census Return, 1901, however, female potters are so classified for Staffordshire as a whole, and, as there can be but few women potters in the county outside the Potteries proper, I have taken the Staffordshire figures as being sufficiently near the mark for arriving at the number of women workers to be examined between the ages 25 to 65, and I find the total of both sexes amounts to 21,700 approximately.

At the rate of 30 per day, and allowing 250 working days, I estimate that this number could be examined by three medical men in one year. Probably the services of junior, though experienced, medical men could be obtained for a salary of £300, in which case the cost of obtaining the desired information would be £900.

It may be asked, why not reduce the number of workers to be examined by selecting for that purpose a certain number from each age-group? That, however, would not meet the case, as the chief point we wish to arrive at is the relative risk attending the different branches of the potting industry, and, unless we utilise the whole of the material at our disposal, and not weaken it by too much sub-division, I am afraid that statistically the conclusions arrived at as the result of one examination would be fallacious.

The position then, as I view it, may be summed up as follows: At present we have not got the necessary information to enable us to frame any proposals regarding a compensation scheme. This information could, I think, be acquired in the manner I have suggested, and it seems to me that the Committee at this stage cannot do more than explain the situation, and suggest that the Home Office should provide for the special medical examinaion, from the point of view of lung diseases, of all potters in the Staffordshire Potteries between 25 and 65 years of age. I believe that an investigation such as this would yield results which would prove to be of value in relation to other dust-producing occupations besides that of the potter.

Having acquired the needful information, it is possible, on the case being put to them, that the employers and employees might mutually agree upon a scheme.

Stafford,
8th February, 1910.

APPENDIX XXXV.

Mess-room Accommodation.

Memorandum by Dr. G. Reid.

As requested by the Chairman of the Committee, I have considered the question of fixing a minimum floor area for mess-rooms. Having set out to scale numerous alternative arrangements, I have come to the conclusion that the following sliding scale in accordance with numbers may be regarded as a reasonable one:—

Six persons and under	- -	$10\frac{1}{2}$ sq. feet per person.
Over 6 persons and up to	12 -	$7\frac{1}{2}$ sq. feet per person.
,, 12 ,, ,, ,,	20 -	6 sq. feet per person.
,, 20 ,, ,, ,,	28 -	$5\frac{1}{2}$ sq. feet per person.
,, 28 ,, ,, ,,	any number -	5 sq. feet per person.

The arrangement upon which I finally arrived at this scale is shown diagramatically in the accompanying Plate A, but of course I do not suggest that this is the only way in which the tables can be arranged in order to comply with the scale proposed. In the majority of cases, no doubt, existing buildings will be utilised and the plan of seating will necessarily be governed by the shape of the room, in order that the space available may be utilised to the best advantage. For example, an alternative arrangement is shown in Plate B, which illustrates the seating arrangement adopted in a mess-room at one large pottery. In this case it will be noticed that the space between the tables is only 2 feet 9 inches, compared with 4 feet in the other arrangement, but here the tables are short, three persons only being located to each side, therefore there is not the same need for passage room as there is in the case of longer tables.

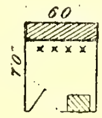
Stafford,
8th February, 1910.

PLANS OF MESS-ROOM SEATING ACCOMMODATION.

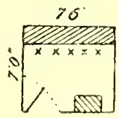
× denotes a seat; ▨ a table; ▧ a place for cupboards, cooking stoves, or other fixtures.

A

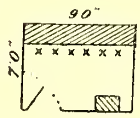
Area - - - 42·0 sq. ft.
Persons - - - 4
Space per person - 10·5 sq. ft.



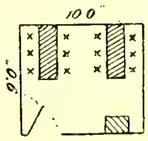
Area - - - 52·5 sq. ft.
Persons - - - 5
Space per person - 10·5 sq. ft.



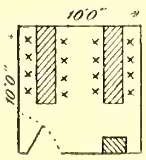
Area - - - 63·0 sq. ft.
Persons - - - 6
Space per person - 10·5 sq. ft.



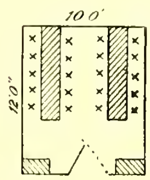
Area - - - 90·0 sq. ft.
Persons - - - 12
Space per person - 7·5 sq. ft.



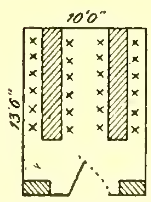
Area - - - 100·0 sq. ft.
Persons - - - 16
Space per person - 6·25 sq. ft.



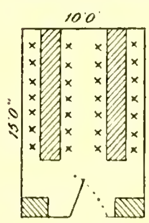
Area - - - 120·0 sq. ft.
Persons - - - 20
Space per person - 6·0 sq. ft.



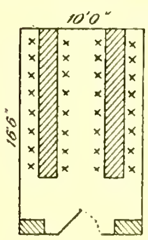
Area - - - 135·0 sq. ft.
Persons - - - 24
Space per person - 5·62 sq. ft.



Area - - - 150·0 sq. ft.
Persons - - - 28
Space per person - 5·36 sq. ft.

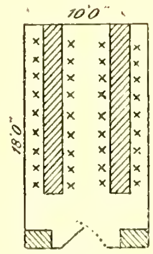


Area - - - 165·0 sq. ft.
Persons - - - 32
Space per person - 5·16 sq. ft.

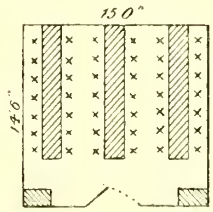


A

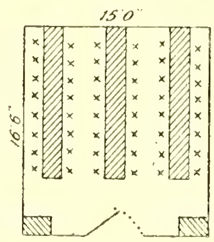
Area - - - 180·0 sq. ft.
Persons - - - 36
Space per person - 5·0 sq. ft.



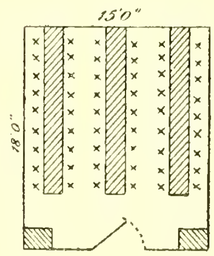
Area - - - 217·5 sq. ft.
Persons - - - 42
Space per person - 5·0 sq. ft.



Area - - - 247·5 sq. ft.
Persons - - - 48
Space per person - 5·0 sq. ft.

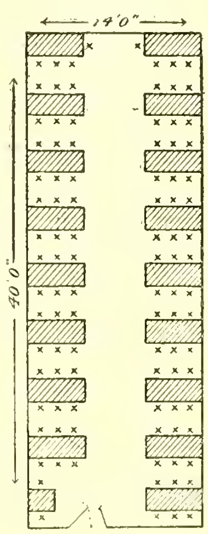


Area - - - 270·0 sq. ft.
Persons - - - 54
Space per person - 5·0 sq. ft.



B

Area - - 560·0 sq. ft
Persons - - - 100
Space per person - 5·6 sq. ft.



APPENDIX XXXVI.

Special Rules and Regulations in which provision of (1) overalls for all workers, (2) warm water in lavatories is prescribed.

Table prepared by J. A. Redgrave, Esq., I.S.O., H.M. Superintending Inspector of Factories.

Industry.	Overalls for *all* workers.	Warm water.
Electrical accumulators	Req. 9	Req. 12
Wool sorting	„ 11	—
Paints and colours	„ 7	„ 10
Heading of yarn	„ 5	„ 6
Nitro-benzine, &c.	„ 10	„ 11
Horse hair	„ 9	„ 11
White lead	„ 14	„ 18
Red and orange lead	—	„ 4
Yellow lead	„ 2	„ 1
Lead smelting	„ 1	„ 4
Enamelling iron plates (old code)	„ 2	„ 1
Tinning and enamelling metal hollowware and cooking utensils (old code)	—	„ 1
Tinning and enamelling iron hollowware (old code)	—	„ 1
Lucifer matches	„ 9	„ 12
Chrome processes	„ 12	„ 14
Chemical works	„ 8	—

APPENDIX XXXVII.

Hours all Lead Workers (except Glost Placers) work each day at the Potteries of Messrs. Johnson Bros. (Hanley), Ltd.

Table supplied by H. J. Johnson, Esq.

	Hanley.		Imperial.		Alexandra.		Charles Street.		Trent.	
	Time each day.	Hrs.	Time each day.	Hrs.	Time each day.	Hrs.	Time each day.	Hrs.	Time each day.	Hrs.
Dippers—										
Monday to Thursday	8 a.m. to 5.30 p.m.	8	8 a.m. to 5 p.m.	7½	7.30 a.m. to 5.30 p.m.	8½	8 a.m. to 5 p.m.	7½	8 a.m. to 5 p.m.	7½
Friday	7 a.m. to 5.30 p.m.	9	7.30 a.m. to 5.30 p.m.	8½	7.30 a.m. to 5.30 p.m.	8½	8 a.m. to 5 p.m.	7½	8 a.m. to 5 p.m.	7½
Saturday	7 a.m. to 1 p.m.	5½	7 a.m. to 1 p.m.	5½	7.30 a.m. to 1 p.m.	5	7 a.m. to 1 p.m.	5½	7 a.m. to 1 p.m.	5½
Hours per week	46½		45		47½		42½		42½	
Dippers' Assistants—										
Monday to Thursday	7.30 a.m. to 5.30 p.m	8½	Same as dippers.		Same as dippers.		Same as dippers.		7.30 a.m. to 5.30 p.m.	8
Friday	7 a.m. to 5.30 p.m.	9							7.30 a.m. to 5 p.m.	8
Saturday	7 a.m. to 1 p.m.	5½							6.30 a.m. to 1 p.m.	6
Hours per week	48½								46	
Dippers' Ware Cleaners—	Same as dippers' assistants.		Same as dippers.		Same as dippers.		Same as dippers.		Same as dippers.	
Printed Ware Cleaners—										
Monday to Thursday	7 a.m. to 5.30 p.m.	9	Same as dippers' assistants.		7 a.m. to 6 p.m.	9½	Nil.		Nil.	
Friday	7 a.m. to 5.30 p.m.	9			7 a.m. to 6 p.m.	9½				
Saturday	7 a.m. to 1 p.m.	5½			7 a.m. to 1 p.m.	5½				
Hours per week	50½				53					
Thimble Pickers—										
Monday to Thursday	7 a.m. to 6 p.m.	9½	7 a.m. to 6 p.m.	9½	7 a.m. to 6 p.m.	9½	7 a.m. to 5.30 p.m.	9	Nil.	
Friday	7 a.m. to 6 p.m.	9½	7 a.m. to 6 p.m.	9½	7 a.m. to 6 p.m.	9½	7 a.m. to 5.30 p.m.	9		
Saturday	6 a.m. to 2 p.m.	7½	6 a.m. to 2 p.m.	7½	6.30 a.m. to 1 p.m.	7	7 a.m. to 12.30 p.m.	5½		
Hours per week	55		55½		54½		50			

APPENDIX XXXVIII.

LETTER received from LAWRENCE WEDGWOOD, Esq. (of Messrs. Josiah Wedgwood & Sons, Ltd.), in reply to an inquiry asking for details of the scheme for alternation of employment of lead-workers, introduced into the earthenware and china factory at Etruria.

Etruria,
Stoke-on-Trent.
February 8th, 1909.

Dear Sir,

In answer to your letter of 5th inst., I will explain, with pleasure, how we arrange the matter you mention. We have five women who take the ware from the two earthenware dippers, and do the thimble picking, and this thimble picking is done in a separate room.

The woman who takes the ware from the dipper, changes weekly, with the woman who supplies the dipper with the biscuit ware to dip. This we have done for about 12 months. Then each dipper's attendant works a month in thimble picking shop, so that each woman avoids a lead process, once in five months, and also has a less leady job every other week. The thimble picking has been in use for five months.—Yours sincerely,

LAWRENCE WEDGWOOD.

APPENDIX XXXIX.

TABLE showing the Imports of Earthenware and China into Great Britain. Compiled from Board of Trade returns, and including the figures referred to by JOHN RIDGWAY, Esq., in his evidence.

	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.
	£	£	£	£	£	£	£	£	£
From France - -	128,764	116,375	93,838	91,392	146,163	274,082	277,459	187,635	257,450
,, Germany - -	246,907	237,196	250,063	240,587	216,876	214,333	243,086	361,544	340,127
,, Holland - -	206,314	232,643	201,867	221,736	233,580	286,487	300,229	214,784	240,908
,, Belgium - -	35,604	24,374	31,288	28,474	33,838	23,699	30,862	27,126	24,777
,, Other Countries	55,723	46,296	48,476	37,383	56,118	46,148	53,152	69,259	57,558
Total - -	£673,312	656,884	625,532	619,572	686,575	844,749	904,788	860,348	920,820

	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.
	£	£	£	£	£	£	£	£	£
From France - -	264,782	284,499	273,102	265,201	203,126	169,441	172,495	196,935	185,938
,, Germany - -	344,351	393,827	384,117	446,626	353,969	342,161	345,863	328,232	311,127
,, Holland - -	221,495	241,629	240,347	253,424	314,482	328,261	336,387	360,074	321,791
,, Belgium - -	46,235	25,142	29,188	26,570	25,993	27,749	33,316	32,940	26,411
,, Other Countries	52,615	53,875	54,727	61,556	60,403	45,947	62,008	85,462	71,489
Total -	£929,478	998,972	981,481	1,053,377	957,973	913,559	949,969	1,003,643	916,756

NOTE.—For the purposes of comparison the imports from Germany and Holland should be taken together, as the bulk of the imports from the last named are German shipped through Dutch ports. JOHN RIDGWAY.

APPENDIX XL.

TABLE showing Exports of Earthenware and China from Great Britain.

Compiled from Board of Trade returns.

	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.
	£	£	£	£	£	£	£	£	£
To Germany - -	50,750	41,346	38,379	40,482	45,804	61,393	69,604	93,560	134,511
,, Belgium - -	19,767	26,218	22,935	27,811	27,890	29,822	36,326	48,379	59,538
,, France - -	64,486	52,953	58,885	70,486	61,899	72,425	75,809	75,166	79,892
,, United States of America -	902,161	918,510	886,449	731,653	955,593	722,154	650,509	540,048	656,017
,, Central and South America* -	219,468	223,323	249,415	174,390	193,994	223,671	159,800	163,364	183,897
,, Other Foreign Countries -	181,534	162,615	150,105	167,847	162,796	207,552	230,484	239,967	275,882
,, British Possessions	669,710	632,076	578,556	546,011	544,357	650,233	677,579	659,331	652,139
Total -	£2,107,876	2,057,041	1,984,724	1,758,680	1,992,333	1,967,250	1,900,111	1,819,815	2,041,876

	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.
	£	£	£	£	£	£	£	£	£
To Germany - -	106,673	86,008	70,961	84,012	74,877	69,146	77,354	88,793	60,710
,, Belgium - -	55,422	45,327	42,276	39,693	46,157	51,108	49,179	59,240	54,174
,, France - -	75,510	60,493	62,591	75,342	62,635	62,327	60,138	65,384	71,589
,, United States of America -	602,635	512,364	498,338	583,864	555,549	508,053	572,465	614,164	465,224
,, Central and South America* -	207,697	203,245	188,009	221,312	278,149	351,781	432,926	464,163	440,999
,, Other Foreign Countries -	270,327	261,007	256,699	265,677	227,672	243,603	292,233	342,155	329,583
,, British Possessions	719,745	824,353	780,725	906,088	861,285	812,205	897,368	1,014,912	921,839
Total -	£2,038,009	1,992,797	1,899,599	2,175,988	2,106,324	2,098,223	2,381,663	2,648,811	2,344,118

* So far as classified; exports of Pottery to a few of the very small States of Central and South America are not distinguished in the published Tables, and may therefore be included under the heading "Other Foreign Countries."

APPENDIX XLI.

MEMORANDUM REGARDING FREIGHTS FOR POTTERS' MATERIALS. BY WILLIAM BURTON, ESQ., M.A., F.C.S.

AVERAGE COST OF TRANSIT OF POTTERS' RAW MATERIALS.

	s.	d.	
From Cornish ports to Mersey ports	3	9	per ton.
„ Dorset „ „	4	3	„
„ Devon „ „	5	0	„
From Cornish ports to Dutch ports	5	3	„
„ „ „ German ports	6	6	„
„ Devon „ „	6	6	„
Inland water carriage from Mersey ports to manufactories situated on waterside in the Staffordshire Potteries—average	7	0	„
Average cartage from canal to potteries in the towns—not on the canal banks	1	8	„
Average cost from German ports to manufactories on the Rhine	2	0	„

COMPLETE COST OF TRANSIT.

	s.	d.		s.	d.	
From English clay ports to German or Dutch Potteries	5	3	to	8	6	per ton.
„ „ „ Staffordshire Pottery Factories	10	9	„	13	8	„

APPENDIX XLII.

TRANSLATION OF A DECREE OF THE PRESIDENT OF THE FRENCH REPUBLIC, DATED 23RD APRIL, 1908.

1. In the lead industries hereinafter mentioned, viz., smelting, cupellation of argentiferous lead, manufacture of accumulators, glass-making, manufacture and use of lead enamels, manufacture of pottery, decoration of porcelain or faience, ceramic chromolithography, manufacture of lead alloys, oxides, salts and colours, employers, directors or managers are required, apart from the general measures prescribed by the Decree of 29th November, 1904, to take special measures for protection and health as set forth in the following sections:—

2. Lead melting pots shall be erected in a ventilated place separated from other workrooms.

Hoods or other means for the effectual removal of fumes shall be provided:—

(*a*) Over the openings for the escape of lead and slag in lead smelting;

(*b*) Before the furnace doors in the manufacture of lead oxides;

(*c*) Above the pots for melting lead or its alloys in the other industries enumerated in section 1.

3. All work with oxides and other compounds of lead capable of giving off dust shall be done, as far as possible, with those substances in a damp condition.

When this work cannot be done in the presence of water or other liquid, it shall be carried out mechanically, in covered air-tight apparatus.

If it is impossible to conform to the requirements of either of the first two paragraphs of this section, the work shall be done under a strong draught so arranged that the harmful products may be intercepted by apparatus suitably placed.

Finally, if none of these systems is possible, the workmen shall be supplied with respirators.

4. Oxides and other compounds of lead, whether dry or damp, in suspension or solution, shall not be handled with the bare hand. The employer shall at his own expense provide for the workers in these operations either gloves made of impervious material, such as india-rubber, or suitable appliances, and shall cause them to be kept in good repair and frequently cleaned.

5. The tables on which these products are handled shall be covered with some impervious material, kept in a perfectly water-tight condition.

The same requirement applies to the floors of the workrooms, which shall also be kept damp.

The floor shall be slightly sloped towards a water-tight receptacle, for collecting the lead substances which are washed down.

The work shall be so arranged that there may be no splashing. The tables, floors, and walls shall be washed at least once a week.

6. Without prejudice to the requirements of section 3, the grinding and mixing of lead products and their use in dusting shall be effected in special places with active ventilation.

If the materials cannot be made damp the workers shall be provided with respirators.

7. Pottery must not be dipped with bare hands in magmas containing litharge, red lead, galena or white lead in suspension.

8. No food or drink shall be brought into the works.

9. Employers shall at their own expense provide and maintain for the use of the workers overalls or clothing for use during work only, in addition to gloves and respirators.

10. In a part of the building separated from the workrooms there shall be provided for the use of the workers exposed to lead dust or fumes a cloakroom and lavatory, kept in good order, provided with basins or taps in sufficient number, a plentiful supply of water, soap, and a towel for each worker replaced at least once a week.

The cloakrooms shall be provided with cupboards or drawers with locks or padlocks, the ordinary clothing being kept apart from the working clothes.

11. A warm bath or shower bath shall be provided each week for the workers exposed to lead dust or fumes.

A warm bath or shower bath shall be provided every day after work for each worker employed either in emptying or cleaning the condensing chambers and flues, or in repairing furnaces in lead works, or in carrying lead coming from stacks in white lead factories, or in packing red lead, or in grinding lead enamels and dry dusting.

12. Employers are required to exhibit, in a conspicuous position in the works, regulations imposing on the workers the following obligations:—

To use the appliances, gloves, respirators, and working clothes placed at their disposal; not to bring into the works either food or drink; to pay great care before each meal to the cleanliness of the mouth, nose and hands; to take the baths weekly or daily, as provided in section 11.

13. The Minister of Labour may, by Order made with the advice of the Consultative Committee for Arts and Manufactures, grant to an establishment, for a specified period, exemption from all or part of the requirements of sections 2^a^, 2^b^, 2^c^, 5^2^, and 6^1^, in any case where it is found that observance of those requirements is practically impossible and that the health and safety of the workers are assured by conditions at least equivalent to those prescribed by the present Decree.

14. Subject to additional postponements which may be granted by the Minister in pursuance of section 6 of the Act of 12th June, 1893 (as amended by that of 11th July, 1903), the delay required for the carrying out of the alterations necessitated by the present Decree is limited to one year from the date of its publication.

15. The Ministry of Labour is charged with the administration of this Decree.

"Journal Officiel de la République Française," 29th April, 1908.

APPENDIX XLIII.

GERMAN STATUTE FOR THE PROTECTION OF USERS OF POTTERY.

TRANSLATION OF THE LAW OF 25TH JUNE, 1887, CONCERNING THE TRADE IN ARTICLES CONTAINING LEAD AND TIN.

Section 1.—Eating, drinking and cooking utensils, as well as fluid measures, shall not,—

(1) be constructed wholly or partly of lead, or of a metallic alloy containing more than 10 per cent. by weight of lead;

(2) be tinned on the inside with a metallic alloy containing more than 1 per cent. by weight of lead, or be soldered with an alloy containing more than 10 per cent. by weight of lead;

(3) be provided with an enamel or glaze which gives up lead at the end of half an hour's boiling with a vinegar containing 4 per cent. by weight of acetic acid.

The provision in heading 2 concerning solder shall not apply to utensils or fluid measures made of lead-free britannia metal.

For the construction of drawing contrivances for the retailing of beer, as well as of syphons for beverages containing carbonic acid gas, and of metallic parts for children's feeding bottles, no metallic alloys which contain more than 1 per cent by weight of lead shall be used.

Section 2.—For the construction of mouth-pieces for feeding bottles, sucking-rings, and nipple-shields, india-rubber which contains lead or zinc shall not be used.

For the construction of drinking cups and of toys (except solid balls) india-rubber which contains lead shall not be used.

India-rubber pipes which contain lead shall not be used as conduits for beer, wine or vinegar.

Section 3.—Those portions of utensils or vessels for the manufacture of beverages which (when used in a manner for which they are intended, or which can be foreseen) come into direct contact with the beverages shall not be constructed in such a way as to contravene section 1.

Preserve jars must be constructed, on the inside, in conformity with the requirements set forth in section 1.

For the storage of beverages, vessels shall not be used in which there is any residual lining containing lead.

For the packing of snuff and chewing tobacco, as well as of cheese, metal foils containing more than 1 per cent. by weight of lead shall not be used.

Section 4.—Punishment by fine not exceeding 150 marks (about £7 10s.), or by imprisonment, shall be incurred by,—

(1) anyone who constructs articles by way of trade in a manner contrary to the requirements contained in Section 1; Section 2, clauses 1 and 2; Section 3, clauses 1 and 2;

(2) anyone who sells, or keeps for sale, by way of trade articles constructed, stored or packed in contravention of the requirements of Section 1; Section 2, clauses 1 and 2; and Section 3;

(3) anyone who uses by way of trade drawing contrivances for the retailing of beer, which do not conform to the provisions of Section 1, clause 3; or who uses by way of trade pipes which contain lead for the conveying of beer, wine or vinegar.

Section 5.—Similar penalties apply to anyone who constructs with the use of lead, mill-stones intended for the manufacture of victuals or luxuries; or who treats the grinding surface with lead; or who uses mill-stones constructed in such a manner for the manufacture of victuals or luxuries.

Section 6.—In addition to the penalties set forth in Sections 4 and 5, an order can be made for the confiscation of the articles which were constructed, sold, kept for sale, or used in contravention of the provisions applicable; as well as mill-stones constructed in contravention of the provision.

If the prosecution or sentencing of an individual is not practicable, an order for confiscation can be made independently.

Section 7.—The provisions of the Law of 14th May, 1879, concerning the trade in victuals, luxuries and articles of use (Reichsgesetzblatt, page 145) remains unaltered. The provisions in Sections 16 and 17 thereof apply also to violations of the provisions of the present law.

Section 8.—This law comes into force on 1st October, 1888.

"Reichsgesetzblatt," 1887, No. 22.

APPENDIX XLIV.

TRANSLATION OF A NOTE BY THE BELGIAN MINISTRY OF INDUSTRY AND LABOUR, BRUSSELS, 9TH NOVEMBER, 1908.

In Belgium the laws and regulations concerning work carried on in the manufacture of pottery and ceramic goods relate to:—

1. The work of women, young persons and children

2. The health and safety of the workers.

So far as the work of women, young persons and children is concerned, the manufactures in question are subject to the Law of 13th December, 1889. Article 7 of this law has, however, been repealed and replaced by Articles 9 and 10 of the Law of 17th July, 1905, relating to rest on Sunday.

The period of daily work, as well as the intervals for rest for young workers engaged in the manufacture of pottery and faïence, in the manufacture of refractory products, as well as in brick-fields and hand-made tile works, are fixed by the special Royal Decrees of 26th December, 1892, and 22nd September, 1896, in accordance with Article 4 of the above-named Law of 13th December, 1889. On the other hand, Article 7 of the Royal Decree of 19th February, 1895, made in pursuance of the same law, forbids the presence and the work of children under 14 in those parts of porcelain and faïence works where dust generated in grinding or sifting is given off freely.

From the point of view of the health and safety of the staff of operatives of all ages, and of either sex, the carrying on of the manufactures in question is subject to the requirements of the general regulation of 30th March, 1905, which applies to industrial and commercial enterprises within the scope of the Law of 24th December, 1903, relating to compensation for injuries resulting from industrial accidents.

Moreover, manufactures connected with the making of pottery and ceramic products are included for the most part among the work classified as dangerous, unhealthy, or likely to cause a nuisance, and are therefore subject to the Royal Decree of 29th January, 1863, dealing with the manner of licensing and the supervision of these establishments. It follows from this that (independently of the general regulations set forth above) the proper authority may in every case make the licence to carry on a particular factory conditional on the special reservations and conditions which are deemed necessary in the interests of the safety, health, and convenience of the public, as well as in the interests of the workers attached to that factory.

Summary of Laws and Decrees Referred to in the above Note.

A.—Law of 13th December, 1889:—

ARTICLE 2.—Employment of children under 12 years of age forbidden.

ARTICLE 3.—Power to forbid the employment of children or young persons under 16, and girls or women between 16 and 21, at work beyond their strength, or which might involve danger for them.

Similar power to forbid, or only to license for a limited number of hours per day for a limited number of days, the employment of children or young persons under 16, and girls or women between 16 and 21, at work recognised as unhealthy.

ARTICLE 4.—General powers to limit, by Decree, the period of daily work of children or young persons under 16, and girls or women between 16 and 21. (See Decree marked B below.)

Article 5.—Women shall not be employed on work during the four weeks following confinement.

Article 6.—Children and young persons under 16, as well as girls or women between 16 and 21, shall not be employed at work after 9 p.m. or before 5 a.m. (Subject to certain exceptions.)

B.—Royal Decree of 26th December, 1892: manufacture of pottery and faïence; and manufacture of refractory products. Extended to porcelain works (22nd September, 1899), and to earthen pipe factories (25th February, 1901).

Article 2.—The period of actual work for children and young persons under 16, as well as for girls or women between 16 and 21, shall not exceed ten hours per day.

Article 3.—The period of employment shall be interrupted by at least three intervals of rest, the total duration of which shall not be less than one hour and a half.

The mid-day rest shall not be less than one hour in length.

C.—Royal Decree of 22nd September, 1896,—

Deals only with brick-yards, and tile-works without power.

D.—Royal Decree of 19th February, 1895:—

Article 7.—In manufactories of faïence and porcelain, the presence and work of children are forbidden in places where dust generated in grinding or sifting is given off freely.

E.—Law of 17th July, 1905:—

Article 2.—It is forbidden to employ any persons to work more than six days per week, the day of rest being Sunday. (Subject to certain exceptions.)

F.—General Regulation of 30th March, 1905 (Royal Decree).

Article 2.—It is forbidden to use damp places regularly as workrooms.

Article 3.—In every workroom there shall be at least 10 cubic mètres (about 353 cubic feet) of space for each operative. The rooms shall be at least $2\frac{1}{2}$ mètres (8ft. $2\frac{1}{2}$in.) high; they shall be at all times suitably ventilated: for this purpose, arrangements shall be adopted for introducing fresh air and exhausting polluted air at the rate of at least 30 cubic mètres (about 1,059 cubic feet) per hour per worker. In the workrooms of establishments in which work of a specially unhealthy character is carried on, the renewal of the air shall be at the rate of at least 60 cubic mètres (about 2119 cubic feet) per hour per worker.

Nevertheless, establishments in use at the date of publication of this Decree, in which the workrooms would not be capable of being altered in such a way as to conform to the above requirements, may be maintained in their present state under the following reservations,—

(1) that measures be taken to secure ventilation under the best possible conditions;

(2) that the number of workers therein employed be not increased;

(3) that no poisonous materials be handled therein, and that they present no other gravely unhealthy character. . . . . .

Article 4.—During intervals of work, if circumstances permit, the atmosphere of the work places shall be renewed by currents of air.

Article 5.—Such measures as are necessary shall be taken to prevent fumes, vapours, gas or noxious dusts from being diffused in the workrooms.

Articles 6 and 7.—Lighting of workrooms to be sufficient.

Article 8.—During the cold season the work places shall be suitably warmed. In summer they shall be safeguarded, as far as possible, against undue rise of temperature.

Article 9.—The workers shall be protected against excessive radiation from lighting apparatus, hearths, furnaces, and any other source of heat.

Article 10.—The work places and adjoining parts of the factory shall be kept in a good state of repair and cleanliness.

Article 11.—Waste products, manufacturing residuals, waste from raw material, sweepings, and generally all débris liable to ferment, decompose or become harmful in any way, shall be removed daily from the workrooms, put aside and regularly cleared away, burnt or buried, so that no nuisance may arise.

Article 12.—The cleansing of the work places shall be done in such a way as to avoid creating dust, and, as far as possible, out of working hours.

Article 13.—In places where considerable quantities of liquids may be scattered about, the floor shall be impervious, and so constructed as to obviate any accumulation.

Article 14.—In places where work of an unhealthy character is carried on the workers shall wear a working garment, which they shall take off before leaving the establishment.

A cloak-room, with lavatories, shall be placed at their disposal.

The occupiers or managers shall prohibit their workers from taking food in places used for handling poisonous materials.

Articles 15 and 16.—Sanitary conveniences.

Article 17.—Either water of good quality, or a hygienic drink, shall be put at the disposal of the staff.

Article 18.—No polluted water shall be used in the workrooms, either for grinding or sprinkling.

G.—Royal Decree of 29th January, 1863:—

Procedure for issuing licences to establishments classified as dangerous, unhealthy or likely to cause a nuisance.

H.—Law of 24th December, 1903:—

Compensation for injuries resulting from industrial accidents.

APPENDIX XLV.

Translation from Netherlands Regulations.—Extract from Royal Decree of the 13th July, 1906, repealing the Royal Decree of the 16th March, 1903, as finally amended by the Royal Decree of the 8th May, 1906, and establishing a regulation for general administration, in accordance with Article 4 of the Labour Law.

Article 1.—The work-places in factories and workshops are classified, as regards the provisions contained in Articles 2 to 9 inclusive, into Categories A, B, C, D, E, F and G.

Category A includes the places wherein, as a preliminary to the manufacture of ceramic goods, enamels or enamelled articles, materials are regularly prepared or worked which contain more than $\frac{1}{2}$ per cent. of their weight in the dry state of lead or compounds of lead other than sulphide of lead (galena, lead-ore), or where these materials are regularly applied to articles, or where injurious effects may arise from the applied materials in the opinion of the authorised inspector.

Article 2.—It is forbidden to employ a person under 16 years of age or a woman in a workplace included in Category A of Article 1, unless the following provisions are observed:—

1. In the workplace there must not be present:—

(*a*) Materials which contain lead compounds and which have not been vitrified by fusion;

(*b*) Materials which contain lead compounds and which yield as lead monoxide more than $2\frac{1}{2}$ per cent. of the weight of the dried material when treated with a weak solution of hydrochloric acid in the manner hereafter described.

One portion by weight of the dry material is to be shaken for an hour, at the ordinary temperature, with 1,000 portions by weight of an aqueous solution of hydrochloric acid, which contains 0·25 per cent. of hydrochloric acid. This mixture is to be allowed to stand for one hour and is then to be filtered. From the clear filtrate the lead is to be precipitated as lead sulphide and weighed as lead sulphate.

2. The principal or manager of the works or undertaking is required:—

(*a*) So far as concerns the young persons or women, to be in possession of a certificate setting forth that the constitution of each person or woman is not of such a nature as to expose him or her to special danger in consequence of this work. The certificate must, after examination, be given, in the form decreed by

the Minister charged with the execution of this Decree*, by a doctor appointed by the said Minister, and cannot remain valid for more than two months;

(*b*) To produce this certificate immediately on demand by one of the officials named in the first paragraph of Section 18 of the Labour Law;

(*c*) To provide a place for the examination, which is deemed to be suitable by the authorised inspector, after consultation with the appointed doctor;

(*d*) If, in the opinion of the authorised inspector, after consultation (if necessary) with the doctor nominated by the Minister charged with the execution of this Decree*, dangers of poisoning exist in the workplace, to carry out the regulation prescribed by the said inspector to remove the dangers.

3. The workplace must, if the mean height is 3 metres or over, contain a free air-space for each worker of at least 7 cubic metres. If the mean height is 2·10 metres or over, but less than 3 metres, the free air-space for each worker must not be less than that given by the formula:—

$$A = \frac{2{\cdot}80\ h}{h - 180}$$

If the mean height is less than 2·10 metres, the free air-space for each worker must not be less than 25 cubic metres.

By mean height is meant, in this article, the mean height between the floor and the ceiling, or, if there is no ceiling, the roof.

In the formula set out in this article, A denotes the free air-space in cubic metres and h the height in centimetres.

4. In the factory or workshop wherein the workplace is situated there must be provided, inside the building, suitable washing conveniences, separated for the sexes, to the number of at least one for every five young persons or women who have simultaneous intervals for rest or meals. In each washing convenience must be provided soap, nail brushes, and towels; there must be provision for the water which has been used to run off, and there must be a supply of fresh water and of warmed water if the authorised inspector deems it necessary. The washing conveniences must, moreover, be installed in accordance with the instructions given by the authorised inspector.

5. Sufficient time must be allowed to young persons and women immediately before the conclusion of each period of work to enable them to make use of a washing convenience, as set forth in sub-section 4.

6. These young persons or women must not take their meals in the workplace.

7. The floor of the workplace must be scrubbed or mopped at least once a week.

8. The floor of the workplace must be suitably constructed and so arranged that it can be kept properly clean and if necessary disinfected.

9. At the commencement of the morning and of the afternoon periods of employment there shall be placed at the disposal of these young persons and women an overall suitably washed and dried and which has not been used after having been washed.

ARTICLE 9.—Exemptions may be granted by, or in the name of, our Minister charged with the execution of this Decree, from the provisions set forth in Article 2, sub-section 3, paragraphs 1, 2, and 3 and sub-section 4.

ARTICLE 10.—(Gives general powers to inspectors to take samples).

ARTICLE 11.—(Gives general powers to deal with dust and fumes in factories and workshops).

ARTICLE 18.—This Decree comes into force on the second day after its publication in the "Staatsblad" and "Staatscourant."

Date of publication—1st August, 1906, "Staatscourant" No. 177; "Staatsblad" No. 204.

French translation—Annuaire de La Législation du Travail, publié par l'Office du Travail de Belgique, 10e année—1906, p. 373.

* According to the final clause of the Decree, this is the Minister of Agriculture, Industry and Trade.

APPENDIX XLVI.

NETHERLANDS REGULATIONS.—Translation of Paragraph 5 of the Royal Decree of the 10th August, 1909, repealing the Royal Decree of the 13th July, 1906, as finally amended by the Royal Decree of the 17th September, 1906, and establishing a Regulation for general administration, in accordance with Article 4 of the Labour Law.

Paragraph 5.—Factories and workshops in which ceramic industries are carried on.

ARTICLE 33.

The provisions of this paragraph relate to work performed in factories and workshops where ceramic industries are carried on, in so far as lead compounds are prepared, applied, or used which contain more lead than ½ per cent. of the weight in a dry condition, in a form other than sulphide of lead (galena, lead-ore), or, in so far as objects are therein treated to which such lead compounds are applied.

This work is classified into categories A, B, C, D, E, F, G, and H.

Category A comprises work in rooms where, or where as a rule, the preparation of glaze takes place, including grinding, sifting, mixing and making of glaze;

Category B—Glazing (dipping biscuit into the dipping tub or applying glaze in any other manner, e.g. by spraying);

Category C—Work other than that belonging to the preceding category, which is performed when applying glaze to articles, namely,—

(1) putting-up (the regular handing of biscuit to the dipper);

(2) taking-off (the receiving of dipped articles);

(3) giving of finishing touches to the coating of glaze, or removing of superfluous glaze, in so far as this is not done in glost placing;

(4) carrying away (taking of dipped articles to the glost-placing shop);

(5) washing of boards, cleaning of tubs;

(6) the taking of saggers to the oven.

Category D—The work which is performed in glost-placing (placing of dipped articles in saggers), or, when no saggers are used, the work consisting in the placing of dipped articles in the ovens.

Category E—The work consisting in the preparation, grinding and mixing of ceramic colours.

Category F—The work consisting in,—

(1) the decoration of glazed articles;

(2) the application of ceramic colours to articles by spraying or dusting;

when either is done in a manner which is considered dangerous by the principal inspector for the district in consultation with a medical officer of the Labour Inspection Department.

Category G—The work consisting in,—

(1) the application of ceramic colours to biscuit or glost ware by printing or painting;

(2) the decoration of dipped articles or the application of ceramic colours to articles by spraying or dusting;

when either is done in a manner which is considered but little dangerous by the principal inspector for the district in consultation with a medical officer of the Labour Inspection Department.

Category H—Work not mentioned in the foregoing categories carried on in rooms where work belonging to one or more of the foregoing categories is done, and in circumstances in which there is danger of poisoning in the opinion of the principal inspector for the district in consultation with a medical officer of the Labour Inspection Department.

For purposes of this paragraph there shall be understood,—

by *biscuit*, baked ware not covered with varnish or glaze;

by *glaze*, the mass with which biscuit is covered in order to obtain a vitreous coating by heating;

by *glost ware*, the earthenware on which the glaze has been changed into a vitreous coating by heating.

ARTICLE 34.

It is forbidden to cause a person under 16 years of age, or a woman, to perform work belonging to Categories A, B, E, or F of Article 33.

ARTICLE 35.

It is forbidden to cause a person under 16 years of age, or a married woman, to perform work belonging to Category C of Article 33.

It is forbidden to cause an unmarried woman to perform such work unless, in respect of her, the provisions of Article 21, Sub-sections 4, 5 and 7, and of Article 25,

Sub-section 1, as also the following provisions, are observed:—

1. The glaze to be applied shall contain no lead compounds which have not been vitrified by fusion.

2. When treated with an aqueous solution of hydrochloric acid containing 0.25 per cent. of hydrochloric acid in accordance with the method indicated in the last paragraph [of this Article], the glaze to be applied shall not yield more than $2\frac{1}{2}$ per cent. of monoxide of lead in solution.

3. There must be available in the factory or workshop a dated certificate showing that the bodily condition of the woman is not of such a nature that this work would involve special danger for her.

This certificate must be issued either by a medical officer of the Labour Inspection Department nominated by our Minister, or by another medical man nominated by our Minister, and it must be entered in a Register of the form prescribed by our Minister, and which must be kept in the manner also to be determined by our Minister.

The certificate shall not be older than three months; it may be withdrawn at any time by the medical officer of the Labour Inspection Department nominated in pursuance of the preceding paragraph.

The register must be immediately produced for perusal upon the application of one of the officials mentioned in the first paragraph of Article 18 of the Labour Law.

For the purpose of the medical examination a room must be available which is suitable for the purpose in the opinion of the principal inspector for the district after consultation with the nominated medical officer of the Labour Inspection Department.

4. In the factory or workshop no food shall be eaten by the woman, nor shall she remain during a mealtime, except in a room set apart for meals and fitted up in accordance with the requirements made by the principal inspector for the district.

The method mentioned in the second paragraph, Sub-section 2, is as follows: One part by weight (if possible 1 gram) of the substance dried at 100deg. C. to a constant weight is shaken for one hour with 1,000 parts by weight of an aqueous solution of hydrochloric acid containing 0.25 per cent. of hydrochloric acid. The mixture is then allowed to settle for one hour, after which the liquid, which is settled as much as possible, is drawn off by a syphon and completely clarified by filtration. In a known part of the clear filtrate, which must, however, not contain less than three-quarters of the original quantity of liquid, the lead is precipitated as sulphide of lead by means of sulphuretted hydrogen. The sulphide of lead is next dissolved by heating with dilute nitric acid (S.G. 1.2). After removing the excess of nitric acid by evaporation on the water-bath, the lead is precipitated as lead sulphate by means of an excess of dilute sulphuric acid with the addition of double the volume of alcohol. If besides the lead sulphate, other salts, which are precipitable by alcohol, are contained in the solution, no alcohol is added. After at least twelve hours have elapsed the lead sulphate is separated by filtration; if precipitated by means of alcohol, it is washed with this liquid, and if no alcohol was added for precipitation, first with dilute sulphuric acid and afterwards with alcohol. The weight of the precipitate is next ascertained after heating it to a dull-red heat and cooling it down in the desiccator. Finally the weight of monoxide of lead is calculated from the weight of lead sulphate found.

Article 36.

It is forbidden to because a person under 16 years of age to perform work belonging to Category D of Article 33.

It is forbidden to cause a woman to perform such work unless the provisions of Article 21, Sub-sections 4, 5, and 7; of Article 25, Sub-section 1; and of Article 35, Sub-sections 1, 2, 3, and 4, are observed in regard to her.

Article 37.

It is forbidden to cause a person under 16 years of age, or a woman, to perform work belonging to Category G of Article 33, unless the provisions of Article 21, Sub-section 7, are observed in regard to him or her.

Article 38.

It is forbidden to cause a person under 16 years of age, or a woman, to perform work belonging to Category H of Article 33 unless, in regard to him or her, the provisions of Article 21, Sub-sections 4, 5, and 7; and of Article 35, Sub-sections 3 and 4, are observed in so far as compliance with those provisions is necessary in the opinion of the authorised principal inspector for the district.

Summary of requirements in Sub-sections in Articles 21 and 25 referred to.

Article 21.

Sub-section 4.—Weekly provision of a clean overall for young persons under 16, and women, marked for the exclusive use of the worker to whom it is supplied.

The District Inspector may prescribe more frequent provision of a clean overall, and the shape and manner of marking the overalls.

Sub-section 5.—Cloak-room for outdoor clothing put off during working hours.

Sub-section 7.—Washing accommodation within the building, separated according to the sexes; the number of washing places to be so large that not more than five persons having simultaneous periods of rest need make use of the same washing place. Soap, nail-brushes and towels to be available. Provision to be made for escape of dirty water and supply of clean water. (Warm water to be supplied, if considered necessary by the district inspector.) Sufficient time to be allowed at the termination of each period of work for the use of the washing place.

Article 25.

Sub-section 1.—Free air-space for each worker of at least 10 cubic mètres; in calculating the free air-space, only those parts of the room of which the height amounts to three mètres or more to be taken into account.

Date of publication of this Decree—12th August, 1909, "Staatsblad" No. 290.

APPENDIX XLVII.

Standards of Exhaust Draught.

Letter from J. A. Redgrave, Esq., I.S.O., H.M. Superintending Inspector of Factories.

35, Paradise Street, Birmingham.
31-10-08.

Dear Sir,

With regard to existing Rule 10 and improvements in exhaust ventilation, I beg to draw your attention to the requirements on this point in the Draft Regulations (dated October, 1908) for the grinding of metals and racing of grindstones, which prescribe particulars for an effective exhaust installation without setting up a *standard*. Regulation 1 (*a*) (*b*) (*c*) (*d*).

The wording appears to me sufficiently precise to meet most difficulties in deciding the question of *adequacy*.

Yours truly,

The Chairman. J. A. Redgrave.

The regulation referred to reads as follows:—

1. No dry grinding and no finishing process included in Schedule II. shall be done without the use of adequate appliances for the interception and removal of the dust, as near as possible to the point of origin thereof, and for the purposes of this Regulation the appliances shall not be deemed adequate unless they include:—

(*a*) a hood, so constructed, arranged, and placed as to intercept the dust thrown off; and

(*b*) a duct of adequate size, air-tight, and so arranged as to be capable of carrying the dust away from the hood, which duct shall be provided with sufficient means of access for inspection and cleaning, and shall be kept free from obstruction; and

(*c*) a fan or other efficient means of producing an exhaust draught, sufficient to carry away the dust; and

(*d*) adequate provision for the proper disposal of the extracted dust so that it shall not enter any occupied room.

APPENDIX XLVIII.

REPORT ON SYSTEMS OF VENTILATION IN USE IN POTTERIES.

By C. R. Pendock, Esq., one of H.M. Inspectors of Factories.

Part I.—General Report.

ON THE USE OF FANS FOR LOCAL EXTRACTION OF DUST.

Very nearly all the fans used in potteries are of the propeller type. Most of these have scoop blades, which are much less efficient for dust removal purposes than those with plain fin blades, similar in form to the wing of a bird or the propeller of a steamship.

Propeller fans have many advantages; they are light in weight, light running, cheap and easily fitted to work in almost any position; they are also easily cleaned and can be usually made much more accessible for inspection than cased-in fans of the centrifugal type.

They need, however, to be carefully selected with a view to the work they have to perform; and fitted up with due regard to the fact that a free outlet is as essential as an unobstructed inlet. The chief weakness of the propeller type of fan is that it will not work with any real efficiency against any but the slightest resistance. The fan itself must receive careful attention; frequent cleaning is needed, not only of the blades, but also of the casing and framework, or the flow of air will be greatly impeded by increased friction. (Many instances of this are brought to light in the charts: *See* Part II. of this Appendix).

Its speed should also be maintained at a moderately high rate, as it will generally work better going fast than slow; and the more nearly to its full capacity it can be worked the better, for in passing a constantly large volume of air the blades are more thoroughly wind-swept and keep clean.

It would seem almost unnecessary to point out than a propeller fan whose diameter is twice that of some other fan is not twice, but four times as large as the latter—*i.e.*, that the area varies as the square of the diameter and not as its length; and that the volume capacity of the fan increases with its sectional area. This fact is, nevertheless, often disregarded. A fan of given size will do its best work when operating through a tube of its own size, or nearly so; and if it is set to draw through a number of tubes it is obviously important that these all combine to afford the same passage capacity as the fan itself. If there are ten branch tubes, the whole ten should have a total passage capacity equal to the main duct, though they need not necessarily equal each other in size.

POINTS ACTUALLY NOTED IN EXAMINATION OF FANS IN USE.

The following are the most noteworthy features remarked during inspection:—

Fans are often too large for their purpose; sometimes as much as ten times too large. This is in every case a mistake, but particularly so where the outlet of the fan is exposed to wind pressure. Fans may often encounter a wind current of 880 feet per minute, and as very few fans are in use which create a current approaching this velocity, there is obviously great danger of wind blowing through the middle of the fan and at times puffing the dust contained in the ducts back into the workers' faces. Although the backward blowing of dust from the ducts into the room may seldom occur when the fan is running, it may and does frequently happen when the fan is stopped.

In view of this fact it is a striking omission that in no cases examined were efficient means provided to prevent back draughts. Fans are frequently made to discharge their contents into the yard immediately surrounding the factory; sometimes at a low level and in close proximity to doors and windows through which the dust can re-enter the building from which it has just been withdrawn.

In all the potteries so far visited I have only found one contrivance answering the purpose of a dust settling chamber, *i.e.*, a box for capturing the dust after its passage to or from the fan. The absence of settling chambers in the many exhaust systems inspected affords quite a new experience, such appliances being usually regarded as vitally essential to all dust-extracting plants.

I should advocate their use wherever possible, and think they should be so placed in the system as to intercept the dust before it reaches the fan. This would prevent the fan from fouling, and would have many other obvious advantages if the idea could be carried out.

As regards running at a high or low speed, if a fan of the propeller type is intended to blow its effluent into the open air, it is advisable to use a small fan at a high speed rather than a large fan at a low speed, even when an apparent economy is effected by employing the latter. This will be clear from the following example:—

Suppose the area of fan A to be 4 square feet, and that of B 1 square foot. If the fans be driven at such speeds that each displaces 1,000 cubic feet of air per minute, then with no adverse wind pressure A discharges 1,000 cubic feet per minute through a hole of 4 square feet, and B discharges the same quantity through a hole of 1 square foot. The velocity of discharge from A is therefore $\frac{1000}{4} = 250$ feet per minute; but the velocity of discharge from B will be 1,000 feet per minute.

With a very moderate wind resistance, such as a gentle breeze of 6 miles per hour (or 528 feet per minute), the fan A would be quite overcome, having to withstand a velocity of 528 against its own velocity of 250, or a disadvantage of more than 2 to 1; whereas the fan B, with a discharge velocity of 1,000 feet per minute, would easily overcome the same wind pressure.

With regard to the fitting of fans, the workmanship was sometimes found to be so careless that a tap of the centre-punch would drive the spindle right out of the fan-hub, and other fixings were found to be of the slenderest description. In some instances the fan was actually made to rotate in the wrong direction, so as to blow impure air and dust out upon the workers instead of withdrawing it from them, and that condition of things had continued for months at a stretch.

With reference to the frequency with which fans are found to be of larger size and power than is actually required for the work they have to do, it has been suggested that this really matters very little, so long as the work they accomplish is sufficient to effect the necessary amount of exhaust ventilation. It has also been said that the superfluous expenditure of horse-power is the employer's affair and does not concern the present investigation.

It may be urged, on the other hand, that the general cause of ventilation suffers in the long run from this additional expenditure, and that for the following reasons:—

(*a*) In the larger factories there may be as many as ten or twelve fans in operation, and if these are much larger than they need be, the first cost of their purchase is considerably increased, as well as the horse-power required and the cost of their upkeep.

(*b*) If fans are larger than they need be, then the fittings have to be larger in proportion, increasing the cost of erection and occupying more space than would otherwise be necessary.

(*c*) Large fans running at high speed produce more end-thrust on the bearings, causing increased

friction and more rapid wear. Consequently they need more frequent attention and repair.

(*d*) The more power a fan takes to drive it, the greater is its liability to loss of speed from belt-slipping, fouling, and minor causes; on the other hand, a fan that runs smoothly and freely will maintain a normal speed with so little effort that a slight difference in belt tension, etc., will make much less appreciable difference.

(*e*) As the original cost of purchase, fixing, attention and maintenance of fans in such circumstances may add considerably to an employer's expenses, the additional cost will operate against the willingness of employers to ventilate so extensively as they otherwise would.

When propeller fans are intended to blow through outlet towers, chimneys or shoots, these should terminate at a point above the roof in some form of cowl or terminal which will afford free flow to the air. A revolving cowl which will always turn the discharge current in the same direction as the wind can be most usefully employed. There is a double advantage in discharging above the roof level, for not only is there greater freedom at that point from wind pressure, but the dust is less likely to re-enter doors and windows. The outlet should be slightly larger than the area of the fan, and if it is necessary to change the direction of the effluent this should be effected by an easy bend.

Wind guards are often used, but they are so badly constructed in most cases that they cripple the output of the fan most unnecessarily, often to the extent of 50 per cent. This has frequently been proved by opening the trap door which is sometimes placed opposite the fan as a means of access to the fan-box and noting the difference between the suction at the inside exhaust throats when the fan door was open and closed alternately. (Several instances are also clearly shown in the charts in Part II.)

A very common error in practice is to place a propeller fan with its axis of revolution at right-angles to either the suction or discharge air-ways. Exhaust installations as found in the Potteries probably err more in this respect than almost any other.

The main inlet and outlet ducts should, wherever possible, have their axes coincident with that of the fan.

When a small duct is led into a fan-box it is sometimes made to enter the latter at a point opposite the centre of the fan, which is the weakest spot in every propeller fan. This should be carefully avoided.

Fans are sometimes found to be adversely affected by the counter-draught set up by the furnaces of an adjoining oven, which may be extremely powerful when the oven is at the height of firing, unless the partial vacuum set up in the affected shop can be relieved by suitable inlets from the open air. A cooling oven adjoining a glost-placing shop was found to extract as much as 15,000 cubic feet of air per minute from the room, which would more than counteract the work of a 42 in. fan.

It is essential that a fan and its framework should be kept clean; they are generally found loaded with dust, in extreme cases with as much as ⅜ in. thick on the blades. In one case a pound of dust was scraped off from a 30 in. fan. Several tests were made with fans before and after cleaning, the usual result being a difference of 10 to 15 per cent. of efficiency in favour of the clean fan, or more if the accumulation included tow or cleaning materials like rag, etc.

It should be observed in this connection that fans are often boxed in, or placed in such inaccessible places that they can neither be cleaned nor even observed with such facility and frequency as are necessary. And as no means of testing their speed is provided this method of checking their operation is seldom available. In most cases the spindle ends were capped by the bearings, and there was therefore no available centre at which to apply a speed-recorder, even when a trap door was provided for that purpose, which was seldom. Facilities for using a speed counter should always be provided.

When propeller fans have to draw air through inlets that are much too small for them they are said to be "starved," or unable to obtain the air that they vainly strive to collect from the proper channels. In such cases the currents are short circuited by passing outwards from the blade extremities and inwards at the blade roots. Sometimes the inward current measured at a distance of two feet from the spindle point of a 30 in. fan would be as much as 600 feet per minute.

When fans are driven by means of belting it makes a great difference whether the belt is kept tight or slack, particularly when great demands are made on the power transmitted to the fan. The loss due to belt slipping is also increased by gritty material like flint dust getting between the fan and the pulley, or in other cases it may be dust of a greasy nature, as from colour blowing. This shows one disadvantage of exposing the belt and pulley to the dust in the airways on the suction side of the fan. The belts were found slack in nearly all cases; in some cases the loss of speed amounted to from 50 to 80 per cent. (*See* Chart 17, Plate 10 in Part II.)

Slack belts become a still more important source of loss when the speed is increased by two or more steps from the engine, each involving a separate belt. Such circumstances frequently obtain in potteries.

I regret to say that many instances of negligence were noted in the factories visited with regard both to the cleanliness of the fan and the speed at which it was driven. The charts show the highly important difference which a few minutes of careful attention might make in this respect.

The belts were frequently found to be so slack that by merely pressing a speed recorder lightly against the spindle end the fan would be brought to a standstill.

Rope-driven Fans.—Fans are often driven on the same rope as the usual machinery of a potters' shop, and are found to vary greatly in speed according as the load on the engine is increased or diminished. If uniform speed could be secured, there should be less loss from slip from rope-driven fans than with those having belt pulleys, as the ropes are automatically tightened by suspended weights.

Electric-motor Fans.—Fans which have electric motors coupled directly to the spindles are seldom found to be thoroughly satisfactory in operation; partly because of their comparatively feeble action, and partly because the space occupied by the motor obstructs the air-way. They are particularly unsuitable for very dusty work, and were often found running stiffly and slowly, if not entirely stopped. As the fans themselves are often hidden from view, their action being controlled by a switch which gives no indication of the fan's activity or otherwise, its operation may have ceased for a considerable time before the fact is discovered. In one instance two electric fans placed at the top of a drying tower were found to rotate at nearly the same speed whether the electric motor were switched on or off.

MAIN DUCTS.

Perfect conditions not being always attainable, it should be the aim of the engineer to approach the perfect air-way as nearly as he can, and the perfect air-way is a short, straight, and smooth passage of a capacity which coincides as nearly as possible with the passage capacity of the fan on one hand and the sum total of the passage capacities of all the tributary throats on the other.

If cranks and turns in the air-shaft or branch ducts cannot be avoided, these should be simple, well-rounded, and smooth inside; and whether the duct be straight or crooked it should contain no internal projections or obstructive framework, and no bottle-neck constriction, either in the main or tributary air-ways.

The material of which an air-duct is constructed has much to do with its efficiency. In general practice the advantage lies with steel, sheet-iron, tin, zinc, or other materials having a smooth surface, as these can be made strong and durable, well jointed and weather-proof, and the necessary corners and junctions can also be well rounded to assist the flow of air.

With few exceptions, however, it is unfortunately the practice to construct the ducts of wood. If wood is used, the best kinds for resisting damp and changes of temperature should be selected, or warping, shrinking, and cracking may give rise to considerable leakage. Also the greatest care should be taken to construct "easy" bends and junctions.

Proper proportions should be studied, and the best form of cross-section which the conditions of use will allow should be selected. The more nearly the cross-section approximates to a circle or (if rectilinear) a square the better. To flatten a duct into an exaggerated oblong or elliptical section is to increase the internal surface, retard the flow of air, add to the tendency of dust accumulation and increase the difficulty of cleaning.

For the quick and efficient removal of dust a short, straight duct of small but adequate bore yields the best results.

All main ducts and tributary branches should be arranged so that they may be easily and readily cleaned. To accomplish this one, or better still, both ends of the duct should be made to open sufficiently to permit a brush or scraper being passed from end to end. If the duct is not straight enough to be cleaned by this means, trap-doors or arm-holes fitted with sliding shutters should be provided at frequent intervals.

In preference to fixing a fan at the end of a duct of considerable length, it is better to divide the duct into two halves, and place the fan midway between them. The advantages of this arrangement are considerable. To begin with, the duct on each side of the fan need only be half the original internal area. If the fan is fixed at the end of a duct this should have the same area as the fan. The same work can be accomplished by two fans of half the original size placed at opposite ends of a duct which is also halved in area; or a fan (of the same size as that first considered) can be placed at a central point and draw through a right and left duct of half area each. In such cases each duct can be fitted with a throttle-valve and be used independently; and, moreover, the ducts being shorter, greater uniformity of suction can be secured throughout their length.

If two ducts are operated by one fan care should be taken to make them as nearly as possible equal in length and similar in character. When ducts operated by a central fan have inadvertently been made too long for their passage capacity the defect can be effectively remedied in some cases by placing auxiliary trunks at a slant from the fan box to the point where the suction formerly failed.

Defects actually observed in ducts, especially in main ducts:—

1. Many are too large, and occupy unnecessary space. Some are purposely large enough for men to crawl through and clean.

2. Wooden ducts (and most of those in use in potteries are made of wood) are often constructed in a rough and unworkmanlike manner, with internal ledges, projections, and general unevenness. Some times the wood has been found to warp and crack, setting up leakages which seriously affect the ventilation. Cases were found in which strips, or even an entire plank, had fallen from the side of the duct, leaving an unintentional gap near the fan through which air was sucked, depriving the regular throats and hoods of their proper exhaust currents.

3. Many of the ducts are absurdly small, and the result in loss of efficiency is clearly shown in Chart 2 (Part II.).

4. Ducts are seldom arranged for every part to be continually wind-swept, there being usually many stagnant corners from which dust could not be dislodged without rapid brushing or vigorous dusting.

5. Wooden ducts are often constructed on internal framework, thus reducing the passage capacity, in some cases by as much as 25 per cent.

6. In some cases ducts are built up of two sides, with the wall and floor of the factory for the remaining sides. Where the wall is of rough masonry the friction would be considerable, and if a brick pier projects into the duct there is serious obstruction, the effect of which can be seen in Chart 3.

7. Wooden ducts are sometimes abruptly flattened to pass under a doorway or other obstruction. This also affects the current adversely, as shown in Chart 5. Wooden ducts are almost invariably turned at a dead right angle, and sometimes, when a cut-away corner is provided, the angle piece is joined to the main duct in such a way as to narrow its own capacity by 25 per cent.

8. Ducts made of metal are sometimes bulged or dented, as a result of their being placed where they are exposed to risk of injury, and their capacity is lessened as a consequence.

9. Ducts are sometimes found to be half full of rags, tow, and cleaning materials.

BRANCH DUCTS AND JUNCTIONS.

All junctions should be designed to give a clear, smooth and uninterrupted course for air currents issuing from branch ducts to join the main current in the duct or *vice versa*. Right-angled elbows are very disturbing to the current because they not only give rise to shocks and eddies, but they often cause heaps of dust to accumulate and block the air-ways.

Where the junctions cannot be made tangential to a nicely rounded curve they should enter in a manner that will yield the nearest similar result—say at an angle of 30 degrees to the axis of the main duct.

If the branch is small in comparison with the main duct the angle of inclination may be somewhat larger than when the two connected ducts differ but slightly in quality and size.

It is always inadvisable to place a junction on the outer side of a bend in a main duct, because the current of air traversing the duct will cause an increase of pressure at this point. If the branch pipe joins the main thus, its current will be obstructed by the congestion of pressure just within the bend. If the branch pipe joins the main on the inside of a bend where the pressure is reduced, the suction through it will be powerful.

HOODS.

Hoods vary greatly in size, character and construction. Many of them are imperfect, and amongst the principal defects noticed are the following:—

1. Some are too large and do not concentrate the exhaust current on or about the point of origin of the dust.

2. Some are too wide in front to prevent interruption of the true exhaust current by accidental cross or conflicting currents set up in the room by other means.

3. Some are too high and thus allow the workers to place their heads too far in over the dusty processes.

4. Some are too low, and so interfere with the ease and rapidity with which the work can be carried on.

5. Some are too small in every dimension, and thus cramp the workers if they attempt to make proper use of the hood.

6. Some have front top edges which project so much towards the workers as to be in the way of their foreheads when stooping to their work.

7. Some are too dark, because not fitted with glass sides or top.

8. Some have angles and surfaces liable to deflect the exhaust current unnecessarily and cause eddies inside the hood itself.

9. The throats of some are placed too far away from the point where most dust is created, generally too far back.

10. Many of the hoods form box-like receptacles in which dust accumulates and from which it cannot be easily and safely removed.

This is particularly the case in towing earthenware, when gratings are not provided at the bottom of the hood. Mounds of dust accumulate; wads of tow or tools placed on the top of them raise a quantity of dust whenever they are picked up, and have to be shaken before use.

11. Some used for varying conditions of work—such as blowing colour on articles of different height—are not sufficiently adjustable for their purpose, and, being made high for an occasional large article, retain the same height when used for a run of much smaller goods.

12. Some used in colour blowing have tall backs, which form large upright surfaces, which the dust-laden air currents set up by the injector-like action of the colour-sprayer impinge, and from which they rebound towards the worker.

13. Hoods which are merely suspended canopies with a central upward exhaust current are not only of little use, but may actually do harm in raising and keeping dust particles suspended in the air which would otherwise fall to the floor. Moreover, some of the dust which they draw upwards will settle in flakes on the inside of the hood and upcast pipe; this dust, on being dislodged by a knock or its own accumulated weight, will occasionally descend in an avalanche upon the workers below.

A hood with a sloping glass top (low enough for the worker's head to be above it, and high enough to allow the hands freedom below it) is desirable wherever practicable.

It is also a useful principle not to allow the area of the front opening into the hood to be more than four times the area of the exhaust throat, thereby securing a constant current from the room into the hood (*i.e.*, away from the worker) of not less than one-fourth of the throat velocity.

EXHAUST CURRENTS.

As dust, when left undisturbed by air currents, will always gravitate earthwards by the straightest uninterrupted course, it is generally advisable to encourage this tendency by using a direct downward suction applied closely below the point where dust is given off. The dust is then carried swiftly into the main duct and away to the fan with the smallest possible effort.

Moreover, as the dust-creating point is generally below the breathing level of the operative, a downward current drawn from the comparatively dustless general air, will first reach the breathing plane and freshen it, and will then collect the dust and carry it well away out of breathing distance. An upward current, on the other hand, tends to arrest the natural descent of dust, and by passing through dusty strata before reaching the breathing plane renders the air less fit for breathing than it would be otherwise.

A process or appliance which creates or raises dust, however, may in doing so impart motion to the dust in some other direction than downwards (*e.g.*, towing wheels and aerographs). In such cases it may be useful to follow and encourage the direction thus imparted to the dust particles, so that dust already moving backwards should be withdrawn by backward suction, sideways by sideway suction, and so on.

Still more often it is useful to combine the initial dust direction with the direction of gravitation, and employ a suction that is, for example, both backwards and downwards, or both sideways and downwards.

The direction for exhaust currents, therefore, may be placed in the following order of importance:—

(1.) Downwards only.
(2.) Backwards and downwards combined.
(3.) Sideways and downwards combined.
(4.) Backwards and upwards combined.
(5.) Upwards simply.

The possible exception to this rule would be for currents used in arresting dust too valuable for total rejection, *e.g.*, the expensive colours used in ground-laying and colour-dusting, when the dust carried away unintentionally may amount to as much as 50 per cent. of the value of the colour legitimately used. It is conceivable that in such processes an upward and backward current might be preferable to the other directions. Strange to say, however, it is precisely these processes in which the system of employing upward currents has not once come under notice, whereas in ware-cleaning and earthenware-towing such currents are frequently used.

THROATS (OR EXHAUST ORIFICES).

The exhaust orifices should be proportionate in size to the main duct; neither too large nor too small to supply it to its full capacity. Neglecting allowances for friction, the sum of all the exhaust orifices should equal the passage capacity of the fan and of the main duct respectively. Thus, a 24-inch fan of 450 square inches area would need 10 exhaust throats of 45 square inches each; five throats of 90 square inches each, and so on.

In estimating the volume of air passed through a throat of given size, there should be no misapprehension as to what actually constitutes the effective passage for air. In cases where a slanting branch duct terminates in a hole at the back of the hood, the size of the opening will appear to be much greater than the effective passage capacity of the branch duct itself. For instance, suppose a branch duct, which measures 6 inches by 6 inches internally, 36 square inches is its passage capacity; but the entrance, being cut across the duct at a considerable slant, appears to measure 12 inches by 6 inches, which is not the true passage capacity. The same thing, of course, applies to a large square hole, say, 12 inches by 12 inches, which is cut through the side of a flat duct, whose real passage capacity is 3 inches by 12 inches.

TESTING AIR CURRENTS.

It is of very little use to test the exhaust current by its velocity alone, when comparing the exhaust of one hood with the exhaust of another hood in the same system, unless the areas of all openings are alike, which seldom happens. The best basis of comparison between the exhaust at one throat and that at another is the displacement of air at each in terms of cubic feet per minute.

In practice this is found to vary enormously, from a few cubic feet in some cases to as much as 2,700 cubic feet in an extreme case.

The charts of Part II. will be found to give many instances of extreme variation; and as so much depends upon the shape, size, and disposition of the hood through which the currents pass (or if no hood is used, the size and position of the exhaust orifices) it is extremely difficult to suggest any definite standard respecting the strength or rapidity which should be generally maintained.

In testing the efficiency of an exhaust system, as the areas of the openings into main ducts generally vary, the velocity alone is not an index of their efficiency. The right method of testing the efficiency is to estimate the volume of air in cubic feet extracted by the throat in a given time.

General Ventilation.

FRESH AIR INLETS.

The fresh air inlets should be large enough to admit the maximum amount of air, not only for the current breathing supply, but to meet any special necessity or temporary requirement, such as thoroughly flushing the room with fresh air in meal hours, or cooling on a hot day, etc. They should be many in number and small in area, rather than few in number and large in area. They should be well distributed instead of being confined to any particular wall or local division of the room, and, as far as possible, on opposite sides of the room.

The air should be admitted about 6 feet 6 inches from the floor level, and be given an upward direction by deflectors. It should not flow in uncontrolled streams or columns, nor, if possible, be subject to accidental deflection by counter currents. The inlets should be so arranged as to be beyond the control of the workers.

It is worth noting that in the Potteries there appears to be no attempt at ventilation on the Plenum system; there is nowhere any attempt to blow in fresh air either in winter or summer.

MECHANICAL SUBSTITUTES FOR DANGEROUS HANDWORK.

In some dusty processes hand labour has given way to automatic or semi-automatic mechanical devices, some of which have achieved a certain measure of success, but others of which are still unsatisfactory.

The china-scouring machines are an improvement upon older methods, principally because they give off less dust. The ventilation of these machines, however, is very imperfect. Propeller fans are usually fitted, but this is essentially a case where centrifugal fans would be far more efficient. A quantity of dust is also given off even in these processes, as they still require some hand labour, such as loading the "cradles."

Some flint-sifting machines are carefully arranged, and decidedly beneficial in results, though not yet perfect. In some cases the processes of filling and discharge are not properly covered by the ventilation.

Board-washing is also another process for which machines are being made, and suggestions have been made for their improvement which will shortly be tried.

There is no doubt that these mechanical contrivances can be greatly improved, and attention might be paid to the ventilation of processes attendant on their use with considerable advantage.

The question as to whether such mechanical substitutes can be employed in any other dangerous processes can only be settled by trial; but doubtless the success of one device will lead to the invention of another.

WORKING BENCHES.

Working benches are required for so many different purposes that it is difficult to make any general observation. Many of them, however, are very roughly constructed, with all sorts of odd corners and unnecessary projections which collect and harbour dust. There is room for great improvement in this particular, and if the standard set by some of the leading manufacturers could be followed it would be advantageous. Possibly, also, they might be made detachable to permit of their removal from the wall for a thorough scrub down in every direction when required.

Factory rooms in which the various processes are carried on differ so greatly in size and shape that it is difficult to fix upon any standard form of bench applicable to all, and I have no suggestion to make under this head.

In watching two sets of glost-placers on benches facing each other I noticed that when one man reached up to the higher shelves for ware, frequently disturbing some amount of glaze dust in doing so, the disturbed dust was often carried by a cross-current into the face of the opposite workman. A suggestion made to the manager that a light wooden partition should be carried down between the peg-posts met with a ready response, and the addition of this partition is considered an improvement.

WATER TROUGHS.

The method of using a water trough beneath a dusty process is certainly a good one, and if the dust could be drawn downwards into the water by means of the exhaust current great improvement would be effected upon many appliances in use, and I think the idea is one capable of very useful extension.

PROCESSES NOT SCHEDULED UNDER SPECIAL RULES.

There are many processes not scheduled in the special rules which are very dusty, and the places where they are carried on ought certainly to be thoroughly ventilated.

These processes include flat-knocking, flint-sifting, flinting and bedding in china biscuit placing, emptying china biscuit saggers, earthenware biscuit brushing (*See* Mr. Duckering's determination No. 48*), thimble-picking, and some of the clay processes in potters' shops, including tile-pressing, tile-fettling, clay-grinding, and clay-dust sifting in the tile trade.

HIGH AND LOW TEMPERATURES.

High Temperatures.—There are many processes in pottery work in which the persons engaged are exposed to high temperatures which, judging from my own personal experience, I should consider to be injurious. Amongst the hottest work of this kind would be classed the drawing of hot ovens and incidental processes; but I believe these are already the subject of a special investigation by two members of the Committee.

The persons engaged in dipping houses, particularly those employed in placing and gathering ware on and from the mangles, stillages, and other drying appliances, and those employed in potters' shops in attendance upon (or proximity to) the drying stoves, are also exposed to heat, the ill-effects of which may, in many cases, be obviated by better ventilation. The effect upon my own person of remaining continuously for some hours under the influence of these conditions was decidedly weakening, and the cause of much discomfort. It is quite certain that such conditions are remediable in the majority of cases; and can be corrected by the provision of outlet shafts, leading by preference into an adjacent chimney or to an exhaust fan.

Among the most successful devices for protecting the workers from heat that can be mentioned are the hoods placed at the gathering-end of drying mangles. In one or two cases where these were properly connected to an exhaust fan the temperature of the room could be reduced some 10 degrees in five minutes or so, and the air greatly purified at the same time. Attempts to reduce heat by means of open exhaust fans placed at one side of a building are seldom successful, except locally. It is usually found in summer time that windows near the fan are opened as widely as those on the opposite side of the room, so that the fan simply blows out air which has been sucked in from the nearest window without making much appreciable difference to the general air of the room.

In some cases the heating arrangements are of an unsatisfactory nature. In one particular instance the entire floor consisted of a shallow hot-water tank, so that the workers were practically standing on a hot plate all day; and although wooden trellises were provided for those standing in a fixed position, the resulting discomfort was still considerable.

It is generally urged that high temperatures are necessary for drying purposes; but when proper consideration is given to the subject I think much more effective drying can be carried out by systems which involve lower temperatures with more rapid (but properly controlled) air currents. At any rate, much of the hot and sometimes moist air which is now allowed to escape outwards from the drying stoves towards the workers could be easily diverted into other channels and harmlessly carried off. There should always be a free means of escape to the outside air for hot and moist air from the drying stoves.

Low Temperatures.—In some few works, on the other hand, the workers are exposed in winter to temperatures far too low (temperatures ranging from 40° to 46° have been noted in one or two exceptional cases), mainly of course, in places where no heat is required for the processes carried on, such as tile-pressing, china-scouring, thimble-picking, etc. These are cases of deficient heating arrangements already remediable under the Factory and Workshop Act, 1901, which occur but seldom, and can be easily rectified. Such cases are all the more inexcusable because in potteries generally there is no lack of steam and heat required for other purposes, some of which can generally be spared and diverted for the purpose of warming the workplaces.

* Appendix XLIX.

GENERAL REMARKS.

If publicity can be given to some of the devices already adopted by some of the most enterprising firms, there is no doubt that others will be ready and willing, not only to follow the example already set by these, but to endeavour at the same time to introduce such modifications and improvements as may be necessary and desirable for their varying requirements.

It is probable that the simpler means applicable to modern buildings will be to some extent unavailable for use in the ventilation of older and less convenient buildings and premises; and more often than not adequate ventilation will only be achieved by having recourse to mechanical systems and appliances. These, however, would probably be less expensive than any scheme involving structural alterations to buildings that are not in a fit condition to stand pulling about.

The charts referred to are merely selected examples showing various deviations from the best practice. The principles which it has been attempted to set forth above are, on the other hand, applicable to every exhaust system, and if due weight be given to each point dealt with, there should be no difficulty in securing in all cases an efficiency far in advance of the average noted in potteries at the present day.

As regards general ventilation a well-designed system which would admit, by properly constructed ventilated openings, not less than 50 cubic feet of air per minute for each worker, would probably suffice to ensure the purity of the atmosphere in shops other than those where dusty processes are carried on. In addition to this all windows should be made to open freely, when desirable.

To fix a standard rate of local exhaust for dusty processes is very much more difficult; but experiments are in hand which I am confident will enable a simple standard of exhaust current to be fixed.

PART II.—CHARTS AND DESCRIPTIONS.

NOTE.—Eighteen of the charts referred to are reproduced *on a reduced scale* in the ten plates which immediately follow this Appendix.

CHARTS illustrating the Degree of Efficiency achieved by Propeller Fans when exhausting through Ducts of varying length and capacity; and each Duct connected with a greater or less number of Throats or Exhaust Openings.*

GENERAL DESCRIPTION.

Ducts with Numerous Throats.—The intention of these charts is to show clearly by graphic methods the percentage of efficiency (by which is meant volumetric efficiency), achieved by a given fan when exhausting air through one or more ducts containing a series of throats or orifices, as compared with the estimated output for a fan of the same size and speed when operating with free intake and discharge. Each chart is based on the obvious truth that the volume of air *driven out* by a fan will be equal to the volume of air *drawn in* through all the inlets from which that fan derives its supply. Accordingly each chart is divided roughly into two parts, one part showing by means of a large rectangular cross-shaded column the volume passed out by the *fan*, and the other part showing by a series of slight vertical columns the volume of air (always in cubic feet per minute) drawn through the inlets, which are herein generally termed the "throats."

Broad Central Fan-Column.—It will be conceded that if a fan is capable of moving a definite volume of air per minute, that volume can be represented by a column drawn to a suitable scale. Further, if all the air displaced by the fan has to be contributed by a given number of throats (say 8, as in Chart No. 5, Plate 4) the theoretical contribution of each throat can also be represented by a column of the same height, and of a width corresponding to one-eighth that of the fan-column. Thus in chart 5 the estimated output of a 30 inch fan is represented by a wide central column which is equal in width to all the eight "throat columns" added together, the height of the fan column being represented by a scale which shows 8,500 cubic feet per minute.

Thin Throat Columns.—Now if the conditions were so favourable that a fan capable of displacing a volume of 8,500 cubic feet per minute was drawing air through eight contributing throats, and if each throat were capable of contributing an equal share to the output (as would theoretically be the case), then each throat would contribute an eighth of the total volume, or 1,062·5 cubic feet each; this is also represented on a scale at the left-hand side called the "throat scale." (The value of each unit on this scale is, of course, equal to one-eighth of each unit on the fan scale.)

Right and Left Ducts.—In order that the volume contributed by the series of throats in one duct shall be clearly distinguished from that contributed from the other duct, the throat columns for the left and right hand ducts respectively are placed on the left and right hand sides of the fan column.

Thus far the chart represents (1) the estimated or theoretical output of a fan; (2) the theoretical contribution of each throat to the total; and (3) the theoretical share which should be borne by each duct in pasing air to the fan.

Black Lines show results of Actual Tests.—It remains now to show what part of this theoretical volume is contributed severally by each duct and its individual throats towards the estimated output of the fan. This is done by first plotting to scale on each throat column a dense black line, which indicates by its height the amount of air in cubic feet per minute which has been found by actual tests to pass through that particular throat towards the fan. Thus in chart 5 the extreme left-hand column marked 4 has a dense black line, indicating by its height that 117·7 cubic feet per minute were found to pass through that orifice towards the fan. Throat No. 3 was found to pass 111·32 cubic feet per minute; throat No. 2 186·37 cubic feet, and throat No. 1 313·58 cubic feet per minute, and so on. The black lines now enable us to compare the actual volume contributed by each throat as compared with the theoretical contribution

* This system of estimating the volumetric efficiency of an exhaust fan and its accompanying plant as described in the foregoing remarks, is now used for the first time, and has been devised by the writer of the present report in order that the striking difference between good systems and bad systems may be more clearly shown and accounted for in a way that will be readily understood by those who usually do not possess a practical acquaintance with the subject. And as he is practically certain that many of the defects revealed are capable of eradication, or at any rate great improvement, he trusts that a study of the results shown, together with an examination of the better installations themselves, will lead to some practical improvement in exhaust ventilation appliances generally.

represented by the full height of the column, and in most cases it is comparatively small.

Aggregate Volume from each Duct.—The next step is to draw a line representing the average volume for all throats in each duct; and in Chart 5 the thick dotted line, showing an average of 182 cubic feet, is carried horizontally to a point half way through the fan column. As half the fan column represents the contribution of one of the two ducts, the height of the last drawn line will represent the actual contribution of the left-hand duct towards the fan output. Similarly, a line showing an average of 270 cubic feet is drawn horizontally into the right-hand half of the fan column, and the height of that line represents the actual contribution of the right-hand duct towards the fan output.

Actual Output of Fan.—Knowing up to the present the actual contribution of each throat, and from that the actual contribution of each duct towards the fan output, it is easy to go further; and by drawing a line to represent the mean of all these contributions right across the fan chart, a rectangular figure is obtained which must represent the volume of air actually passed into—and out of—the fan. To distinguish the area representing "actual output" from the remainder of the column, the former is cross-hatched more closely than the latter, and in an opposite direction so as to emphasise the demarcation.

Incidental Losses.—A horiozntal line drawn a short distance below the "actual output line" encloses an area which represents the loss sustained by running the fan in a dirty condition, *e.g.*, 12½ per cent. in Chart 5.

Diagrams showing Disposition of Ducts and Throats.—At the foot of the principal chart a purely diagramatic sketch is made to show very roughly the arrangement of fan ducts and openings, so that points of interest may be seen more clearly. Towards the top of each vertical column figures are given which indicate the area of each throat and the velocity of the air current in linear feet per minute, as found at the time of test from which the chart calculations are made.

Note.—In these diagrams, which very roughly represent the proportions of each duct and throat, no attempt is made to conform to any particular scale; so none is cited.

Single-throated Systems.—In cases where the fan draws its supply through a short straight duct terminating directly in a single throat, it is only necessary to draw a single fan column as in Chart 4.

Remarks and Conclusions.—In looking through the charts, it will be observed at once that the fan-efficiency-column varies greatly with different installations, but will be found invariably highest with the best constructed apparatus. If the air currents are given a short straight course, the volume displaced by the fan will almost reach a maximum. If a long duct is used, and the air-ways and junctions are fairly correct, the volume will be fairly large; if very correct it will be still larger; but if very incorrect it will fall away to a low figure.

The height of each individual throat-column depends upon the throat area multiplied by the velocity; and, even in the same system will be found to vary greatly between a high point near the fan and a low point near the end of duct. A perfectly uniform current is difficult to obtain, even with the very best arrangements; but the installations herein referred to in the majority of cases fall short of reasonable equality between one throat and another. In some cases the worker at one hood gets ten times as much ventilation as one further away; so that if one worker's share is suitable in amount, the other's must be either ten times too much or ten times too little to achieve the desired object.

High efficiency is obtained with those systems which employ the shortest, most direct, and most capacious air-ways connected to the fewest hoods and throats. Simplicity of construction is possible in such cases; is even difficult to avoid. When it becomes necessary to use long, tortuous and many-throated ducts, the lack of knowledge which should govern their proper construction is at once apparent. There is no exception to this statement, as will be seen from all the many-throated charts. If the designing and construction of ducts and hoods, etc., were always left entirely to the local tinsmith or the factory millwright, the shortcoming so frequently found would be less surprising; but when the same ignorance (or at any rate disregard of correct principles) is displayed in installations for which large sums have been paid to well-advertised ventilating engineers, some consideration can be felt for those manufacturers who have endeavoured to obtain good ventilation and been willing to pay for it, but have nevertheless had to put up with inferior systems because the science of ventilation, as practised by many present-day engineers, is so backward.

The more complicated systems fail because of one or more of the undermentioned defects:—

1. The inlets or outlets to the fan are too small (in some cases absurdly so).

2. If not too small, the effective passage of the ducts may be narrowed unduly from an open square section to an exaggerated oblong shape; two opposite sides of the air-way may be so close together as to impede the current and make cleaning difficult; or the ducts may be given abrupt turns and twists that will baffle still more the flow of air.

3. The ducts and throats have a passage capacity which is not proportionate to the passage capacity of the fan. If the duct is too small for the fan it will not convey all the air that the fan should properly draw. If the throats are too small for the duct they will not convey all the air that the duct should properly transmit to the fan, even at the slightly increased velocity which results from their contraction.

4. In some instances attempts are made to equalise the currents by graduating the throat-areas; but this is never satisfactorily accomplished throughout the system. Throats are found to be large near the fan and small towards the end of the duct, when they should be exactly the opposite.

Empirical adjustment of the throat-areas should be always accompanied by a test to ensure that equal volumes of air are passed through equal hoods throughout the system. And if throats are provided with adjustable valves or shutters, these should be so fastened when once adjusted as to prevent the workers themselves from tampering with them. (Such adjustable slides are frequently found to be nearly closed—sometimes entirely so.)

Generally speaking, the best results are obtained when the air-velocity through each throat most closely approximates to the mean air-velocity through the fan itself. Propeller fans, of whatever make and size, do their best work when the mean velocity of the air passing through them is not less than 960 linear feet per minute, or say, 16 ft. per second; and usually not more in the smaller sizes than 1,500 l.f.p.m., or the larger sizes 1,920 l.f.p.m. (25 and 32 feet per second respectively); the velocity, of course, depending upon the speed of the fan. Consequently, if the velocity at any throat is made to exceed that through the fan, the increase will be expensively achieved at the cost of lowered velocity elsewhere. If found to fall much below that of the fan, there will be either some obstruction or incorrect formation of the air-ways to account for it.

THE CHARTS BRIEFLY DESCRIBED.

Plate 1.

Chart 1.—The central column in this chart represents the theoretical output of a 30-in. propeller fan running at high speed; it is stated on the scale as 11,000 cubic feet per minute. This fan exhausts through the throats of 12 hoods, six in each of the left and right hand ducts as shown. There are also two holes in the right hand duct which are marked A and B respectively on the chart; and, which having a much higher velocity from their proximity to the fan, are accorded double width each, so that the height of the black column has in their case twice the value of the black column for single throats. The central fan column is therefore broadly divided into three portions, viz., six narrow strips on the left hand side to represent the throats in the left hand duct; two strips of double width in the middle of the column to represent the holes A and B; and further six narrow strips on the right hand of the column to represent the throats in right hand duct. Reference to the figures showing the "velocity" at the top of each column will show a rapidity of current much

higher in throats near the fan than in those at the end of each duct. So far as the ordinary throats are concerned the volume per throat is equalised to some extent by diminishing the area of throats nearest the fan. One effect of doing this, however, is to diminish the passage capacity of the inlets considerably; for if all 12 throats were wide open their passage capacity would amount to 12 by 36 or 432 square inches, whereas they now only amount to 366 square inches, which, plus 72 square inches for the holes A and B, give a combined area of 438 square inches; or much less than the fan area of 706 square inches. The principal defect of this installation, however, is the unusually small capacity of the ducts, amounting to 276 square inches only, or little more than a third that of the fan area.

It would appear from the chart that if the ducts were made proportional in size to the fan area, and the imperfect junctions and abrupt turns were improved in accordance with the latest practice, a considerable improvement could easily be made in the general efficiency.

Plate 2.

Chart 2.—This chart shows a very similar arrangement to that last described; there being seven throats in each duct. Unfortunately, however, the ducts are both smaller than in the last case, and the lessening in efficiency is very pronounced; the actual output of the fan being less in volume by 50 per cent. than in the preceding case. It will be remarked that the velocity through the nearest throats is abnormally high; that for throat No. 1 on the left hand duct being 2,200 feet per minute, or much greater than the velocity through the fan itself. It is an instance which plainly shows that where the velocity at any point is artificially increased, this can only be done at the expense of much lowered velocity at some other point in the same system; in proof of which it will be seen that the velocity at the end throat No. 7 falls off to 270 feet per minute, or less than one-eighth of throat No. 1. As the air exhausted through the intended channels was found to be small in volume as compared with what might have been expected if the ducts had been of larger size, it was arranged to improve the general ventilation of the room by opening a door on the exhaust side of the fan box; thus affording an inlet area of about one-third that of the fan. Through this opening an additional volume of 3,125 cubic feet was removed by the fan; a volume that is represented by the area shaded a little less deeply than the "actual output" area on the fan column.

Plate 3.

Chart 3.—This chart, which shows the work accomplished by a larger fan than that referred to in Chart 2, shows an even poorer result in actual output. The reason, however, is a totally different one; for the ducts are much larger in this case, being equal to three-fourths of the fan area instead of a fifth. The losses are mainly due to projections and obstructions inside the duct; to square turns, very incorrect junctions, abrupt alterations in the shape of duct and the great inequality between the length of one duct and another.

It will be seen that the three throats in the left hand duct pass a much higher average volume than those in the right hand duct; the difference being as 5:2; this, of course, is due to the short, straight and wide airway which this duct affords in contrast to the long, crooked, many-throated duct on the other side. Taking the throats in the right hand duct and beginning near the fan, the throat No. 1 is seen to convey about half as much air as throat No. 2, merely because it has half the area. The throat No. 2 itself is much too large for its position near the fan, and passes a larger volume at the expense of lowered velocity in the remaining throats. Throat No. 3 is placed first after a right-angled corner, and loses from diminished velocity; a defect which the larger area of throat No 4 partially overcomes. Throat No. 5 has still a larger area and is close to a fresh air inlet which may affect the inflow. Between this throat and No. 6 a brick pier projects into the duct and obstructs the current, causing a congestion of pressure under throat No. 6 which seriously retards the flow of air through that orifice; although its area has been extended in an attempt to overcome the defect. After a slight improvement in throat No. 7 the volume at throat No. 8 is seriously diminished owing to an abrupt flattening of the duct, which sets up local congestion and hinders the inflow of air. The volume of throat No. 9 does not suffer to the same extent, being farther removed from the seat of disturbance.

Plate 4.

Chart 4.—This chart shows a fan column of entirely different character and represents the work of a 12-in. electric fan operating through a short, straight duct which terminates in a large, wide throat having a passage greater than the fan itself. Consequently the capabilities of the fan (in itself far from powerful) are utilised to much better effect. The output is still further improved when the outer door of the fan box is removed to relieve the pent-up current caused by a turning in the outflow shaft.

Chart 5.—This chart shows the work of a 30-in. fan connected to a system of ducts and throats having some characteristics similar to the last. Although the ducts are fairly large, they are internally obstructed at many points by the frame-work of machines which project into the air-ways. The fan itself, moreover, is below the ground level, and discharges into a square chamber surmounted by a cast-iron grid which has an effective passage capacity less than that of the fan. This constitutes a serious impediment to the outflow. A horizontal line drawn across the central fan-column just below the line of actual output indicates the percentage of loss arising from the dirty condition of the fan, from which a pound of dust was collected before the final test. The small volume displaced at throats Nos. 3 and 4 in the left-hand duct again show the disadvantage of abruptly flattening the duct to pass under a doorway.

Plate 5.

Chart 6 shows the work accomplished by the most efficient system inspected (having regard to the length of duct and number of throats therewith connected). The installation consists of two ducts running parallel and back to back. They are both straight and capacious, and are so arranged as to lead directly up to the fan at right angles to the plane of the latter's rotation. As this is the only instance in which a fan is so correctly approached by the principal air-ways it is worth recording, especially as the results are seen to be highly beneficial. Each duct is surmounted by seven hoods; and, as the arrangement of each set is almost precisely similar, the chart is built up from tests made with one set only. Each hood has two throats, one in the bottom (or floor) of the hood marked B in each case, and another a little way up in the back of the hood near the top called T. The throat columns are therefore arranged in pairs, and the sum of two black lines above each hood will represent the total volume extracted from the two throats combined. The totals are given in figures for each pair, and will be seen to range from 378·6 cubic feet per minute near the fan down to 160·5 at the extremity of the duct. The exhaust currents, therefore, are not so uniform as they might have been if the junctions had been correctly made to guide the tributary currents into the main duct without retardation of the general flow; or a fair degree of equalisation might have been obtained by graduating the throats, which are, or were at the time of test, too nearly of one size; there were accumulations of cotton wool, rags, and dust on the floor of each duct which probably affected the general output adversely; and the outflow from the fan was also obstructed by the bad formation of the fan box. The increased output when the outlet was relieved by opening the inspection door was considerable, and is shown by the less deeply-shaded area immediately above the "actual output" line in the fan-column.

Plate 6.

Chart 7.—This chart is valuable, as showing the advantage of large ducts over small ones when connected to the same large fan. The throats on the left-hand side of the fan-column are large in area and lead into a straight, capacious duct directly connected to the fan. Their average volume is, therefore, 512 cubic feet per minute. The thoats on the right-hand side of the fan are smaller in themselves, and are connected by an absurdly small pipe which forms a long and crooked air-way to the fan. The result is

shown in the miserably small amount of air which they contribute towards the general output; the average volume per throat being only 72·5 cubic feet or only one-seventh of the average volume passed through throats in the larger duct.

It will be noticed that the efficiency of throats 1 and 2 in the smaller duct is remarkably less than that of the remaining three. This is because the uptake A, having a capacity of 38·5 square inches only, is not even large enough for the two throats 4 and 5, and is, therefore, much too small for the three numbered 1, 2 and 3, the first two of which suffer the most loss, being farthest from the uptake. Moreover, the throat No. 1, though apparently nearest the fan, is really the farthest away from it, if the distance be measure along the air-way. It should also be added that the duct contained much dust at this point.

The outlet from this fan was again very badly baffled, owing to the shape of the fan box and discharge shaft. The output was increased nearly 50 per cent., as shown in the fan-column when this congestion was relieved by opening the fan box door.

Chart 8.—This chart shows the work of a small system in which the hoods are somewhat similar to those described in Chart 6 Plate 5, and are used for a similar purpose. The duct, however, is differently arranged, and the course to the fan much shorter. The difference between the volume displaced at the right-hand throats and that displaced at the left-hand is probably accounted for by some obstructive accumulation in the left-hand duct. The general efficiency is somewhat higher because the throats are fewer, and there is a shorter course to the fan.

Plate 7.

Chart 9.—This chart shows the high degree of efficiency obtained by a 24-in. fan drawing through a very well arranged iron cylindrical duct of capacity equal to that of the fan terminating in three sister throats arranged as in the diagram at foot of chart. There is no defect in construction, and the result is accordingly very good.

Chart 10.—This chart shows the almost complete failure of a small plant in which almost every possible defect was found to exist. Both inlets to and outlet from the fan were contracted. The duct was very roughly constructed and the junctions were at right angles. The throat nearest the fan took nearly all the available current and the general output was adversely affected by the dirty condition of the duct, which was half choked with flint dust. This installation affords an interesting comparison with the preceding one (Chart 9), the ducts being of similar length, but of widely different formation.

Chart 11.—This chart shows the work of a fan exhausting from a flint-shifting machine, which machine in itself is fairly efficient. But in order to lessen the discharge of clouds of dust into the air the fan outlet was severely contracted by placing stones on the top of the chimney forming the upcast. Consequently the work of the fan is greatly impeded.

Chart 12.—This chart shows the work accomplished by a fan attempting to draw air through the very small pipe which is attached to the hub of a china-scouring machine. The passage of air through one of these machines is extremely difficult, and a propeller fan is totally unsuited to the work. The chart shows the very poor result obtained.

Plate 8.

Chart 13.—This chart shows the work of a large fan coupled to a somewhat complicated system of ducts and throats applied to various purposes. Next to the fan on either side there is an open throat whose passage capacity is capable of supplying a large percentage of the air required to satisfy the fan. This is shown by the horizontal lines in the two central divisions of the fan-column which represent the volume displaced at these two nearest throats, the larger of which extracts air from a flint-sifting machine, and the smaller from an "ark" in which flint is deposited. After satisfying the big demands of these large throats it naturally follows that the air currents through the more distant and smaller ones are comparatively ineffective; especially when these are approached by branch ducts of small capacity, incorrect junctions and squared corners as seen in the diagram at foot of chart. The effect of placing a comparatively large throat in the centre of a T piece is seen at Nos. 2, 4 and 7 of the left hand duct. The black lines for those throats are much higher than the neighbouring ones, when the intention was that they should be equal. In the similar triple arrangement shown at the extreme end of the right hand duct, however, the central throat draws the smallest volume of the three. This is because its area is less than half that of the other central throats; and in fact these three throats combined are a third less in area than the corresponding three throats on the opposite duct, the uptake A, on the other hand, being slightly larger than B. The openings lettered A and B are really situated on opposite sides of the same duct, and the difference in their volumes can only be due to some internal obstruction undiscovered at the time the test was made. The efficiency of the system would have been greatly increased if the ducts had been made much larger to correspond with the size of the fan, and if due attention had been given to the correct formation of junctions, turns and outlet.

Plate 9.

Chart 14.—This chart shows the work done by a fan which is badly connected to right and left ducts of very unequal lengths, and the inlets to and the outlet from which are all severely contracted. It will be seen that although the combined areas of the throats closely approximate to that of the fan, the ducts which have to convey the collected currents are considerably less in passage capacity than either. The throats in the left hand duct are nearly three times too large for the duct itself; and the result is shown in the "tailing-off" of the volume transmitted through the distant ones; from nearly 200 cubic feet at throat No. 1 to 31 cubic feet at throat No. 5, although the throats are gradually enlarged to meet the difficulty. The general result is shown in an extremely small output, viz., 827 cubic feet out of possible 6,600. The small actual output was increased nearly 50 per cent. when the fan door shown in diagram at foot of chart was fully opened and allowed to remain so.

Chart 15.—This chart shows the very small amount of work done by a fan operating through two throats only, and which therefore should be highly efficient. The low result is due to the absurdly small outlet and comparatively small inlets to the fan, as well as to the generally unsatisfactory nature of the connections. With a very slack belt the speed of this fan was only 480 revolutions per minute, which was increased to 960 when the belt was tightened.

Plate 10.

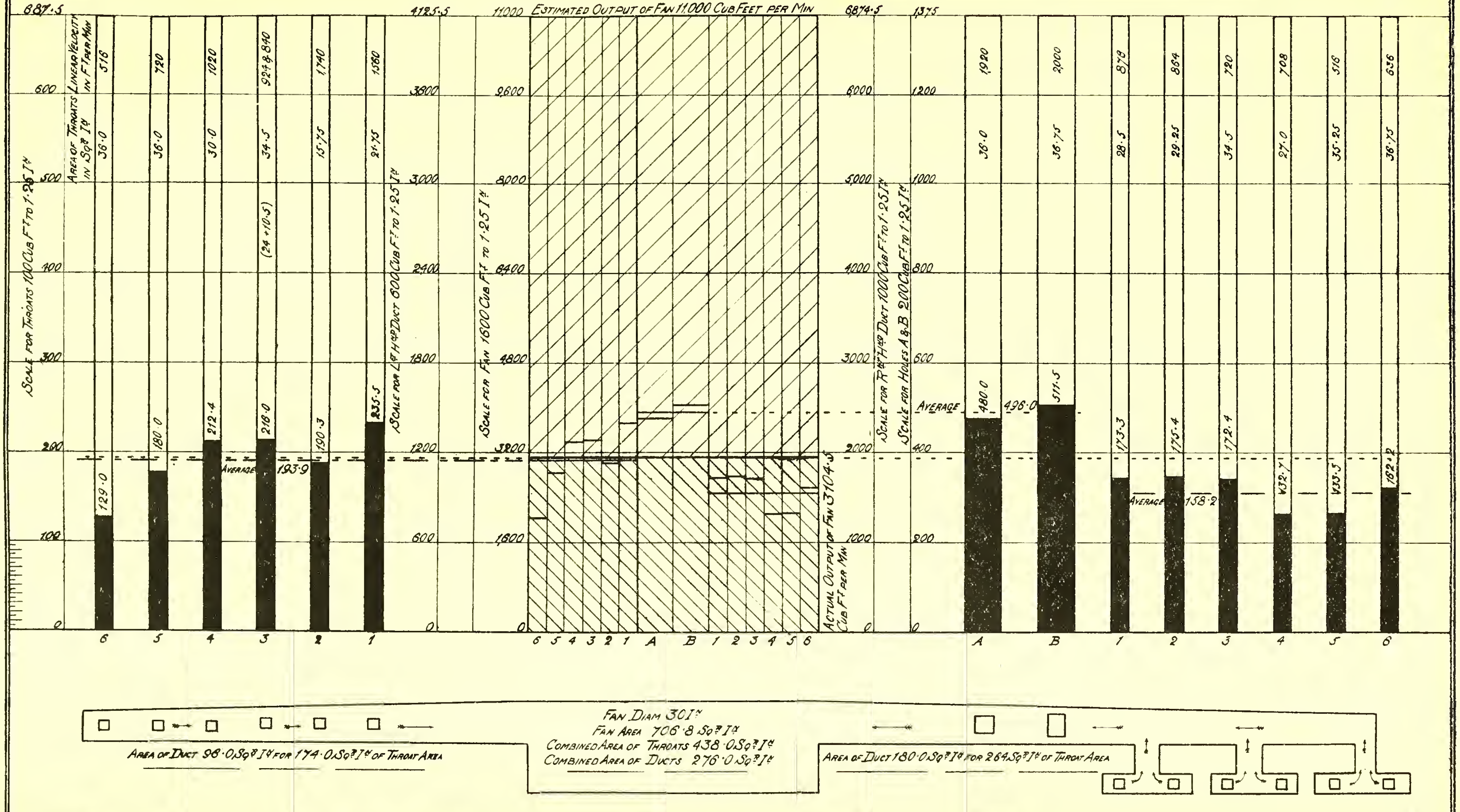
Chart 16.—This chart shows the work of a team of four fans, each operating through a short capacious exhaust duct terminating in two large throats of adequate area. As the fans themselves have a perfectly free discharge into the open air, and there is practically no obstruction to the air currents, a high degree of efficiency is attained in each case. The variation in output between one fan and another is principally due to slackness of the driving belt.

Chart 17.—This chart shows a fan-column *only*, because the fan operates through a single throat of fair capacity placed over the end of a drying mangle. Its chief object is to show the extraordinary variation of output due to the slack or tight condition of the belt, and the clean or dirty condition of the fan itself. When first seen the belt was found to be very slack; the speed of the fan was only 210 revolutions, and the output 355 cubic feet per minute. By merely applying a mixture of resin to the belt the speed was increased to 830 revolutions, and the output to 1,406 cubic feet. After cleaning the fan the speed rose to 890 and the output to 1,507 cubic feet; whilst, on finally tightening the belt to its normal condition the output obtained was 1,660 cubic feet at a speed of 980 revolutions per minute.

Chart 18.—This chart shows the small amount of work accomplished by a fan operating through four throats only, and which for that reason should have been highly efficient. But the fan was placed at a great distance from the throats and the connecting duct was too small, long and tortuous, with very incorrect corners and junctions. The result is seen in a much lower efficiency than should have been possible in the circumstances.

PLATE 1.

Chart 1, showing the Volume of Air in cubic feet per min. Displaced by a 30-inch Propeller Fan, Exhausting through 14 Orifices. wherein is shown that Moderate Uniformity of Suction is obtained by Graduating the Throats: but the Ducts used are Too Small for High Efficiency. —



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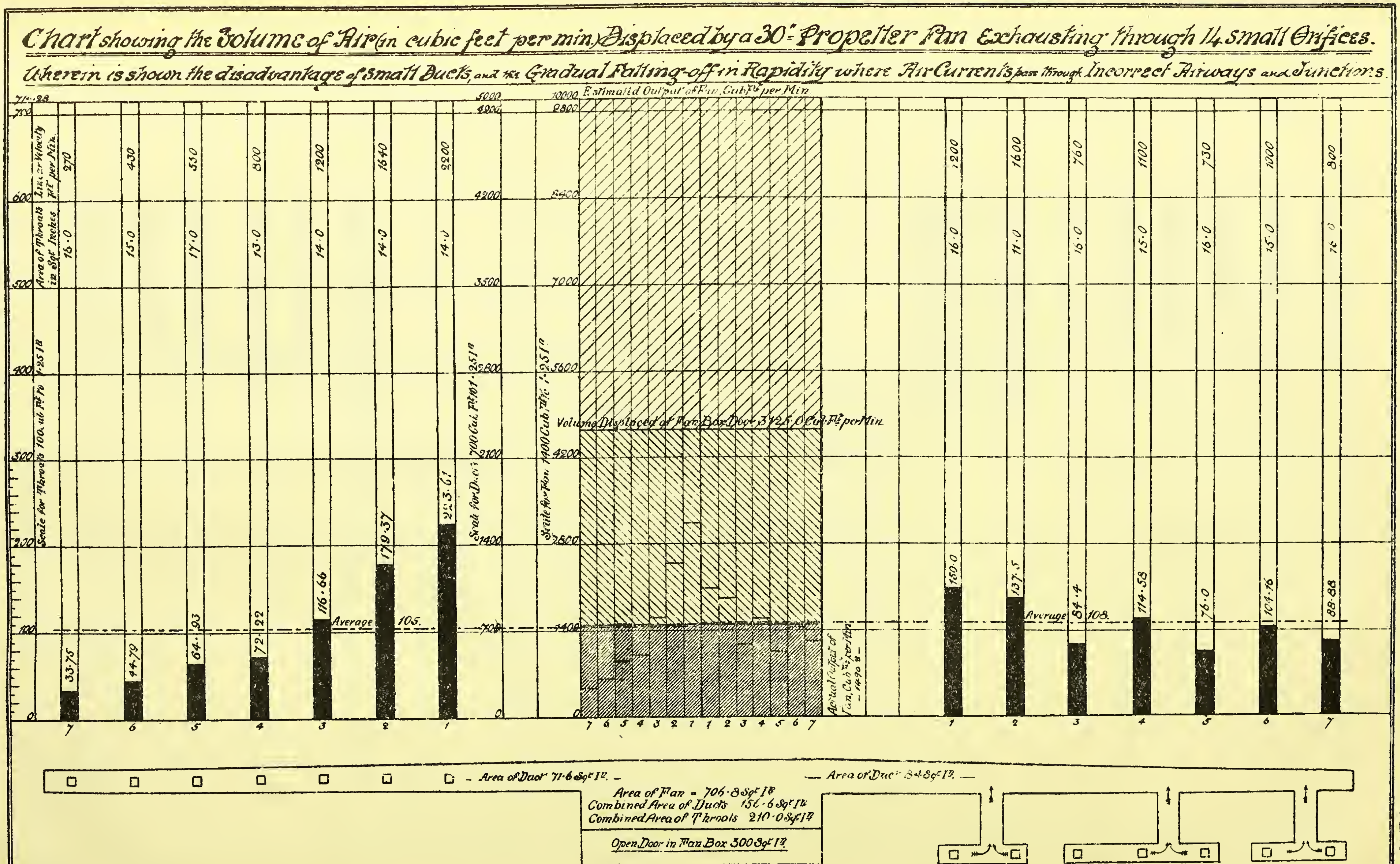
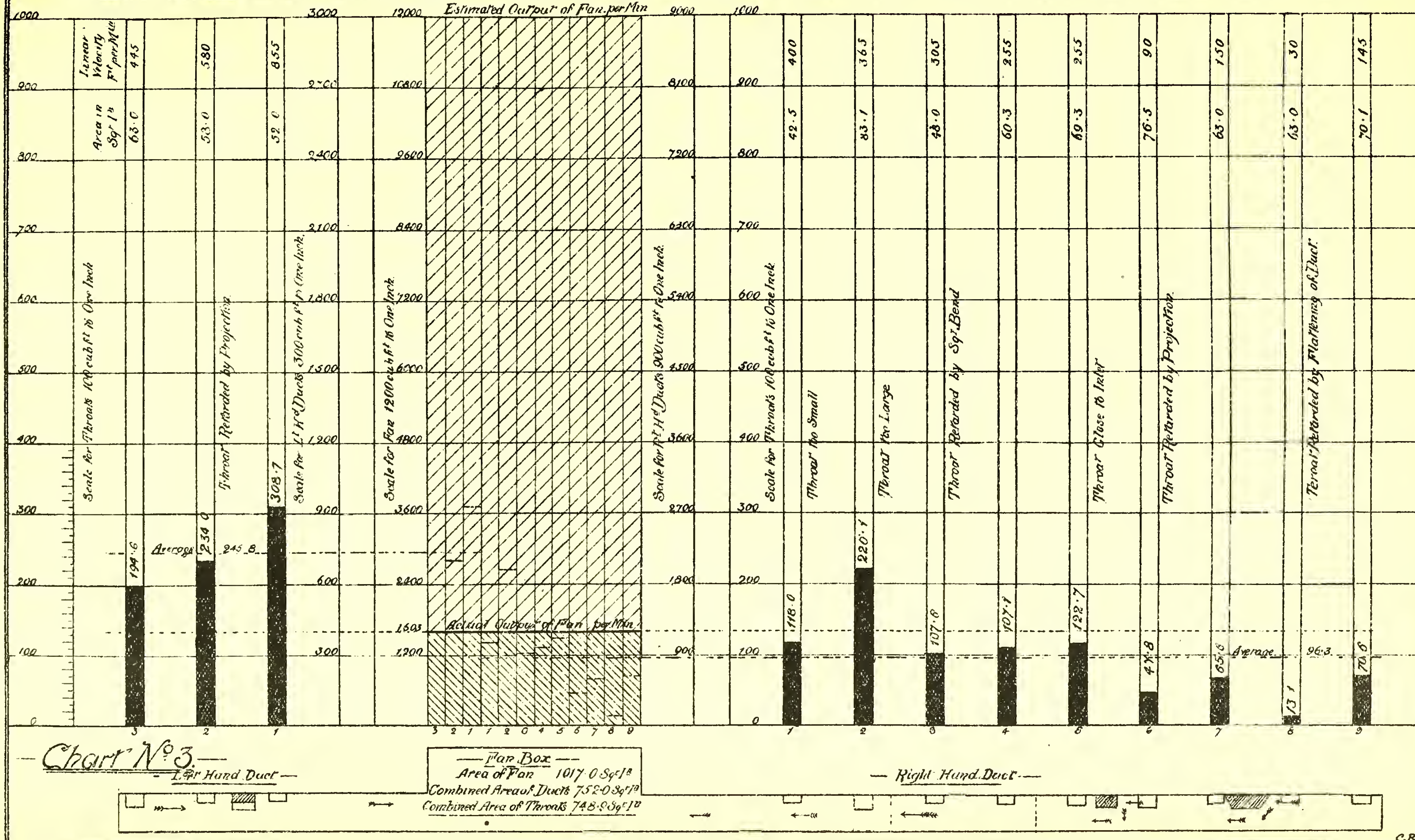


Chart showing the Volume of Air (in cubic feet per min.) Displaced by a 30" Propeller Fan Exhausting through 14 small Orifices.
Wherein is shown the disadvantage of Small Ducts, and the Gradual Falling-off in Rapidity where Air Currents pass through Incorrect Airways and Junctions.
Linear Velocity Ft. per Min.
Area of Throats in Sq. Inches
Scale for Throats 100 cub. ft. to 1·25 in.
Scale for Ducts 700 Cub. Ft. to 1·25 in.
Scale for Fan 1400 Cub. Ft. to 1·25 in.
Estimated Output of Fan, Cub. Ft. per Min.
Volume Displaced at Fan Box Door 3425·0 Cub. Ft. per Min.
Actual Output of Fan, Cub. Ft. per Min. — 1490·8 —
Average 105.
Average 108.
33·75
44·79
64·93
72·22
116·66
179·37
223·61
150·0
137·5
84·4
114·58
76·0
104·16
88·88
Area of Duct 71·6 Sq. In.
Area of Duct 84·8 Sq. In.
Area of Fan = 706·8 Sq. In.
Combined Area of Ducts 156·6 Sq. In.
Combined Area of Throats 210·0 Sq. In.
Open Door in Fan Box 300 Sq. In.

Chart No. 2.

No. 3.

Chart showing the Volume of Air in cubic feet per minute Displaced by a 36-inch Propeller Fan exhausting from 12 different Orifices — wherein is shown the Heavy Loss in Efficiency caused by the Ducts being Faulty in Construction, Obstructed Internally & Disproportionately Small —



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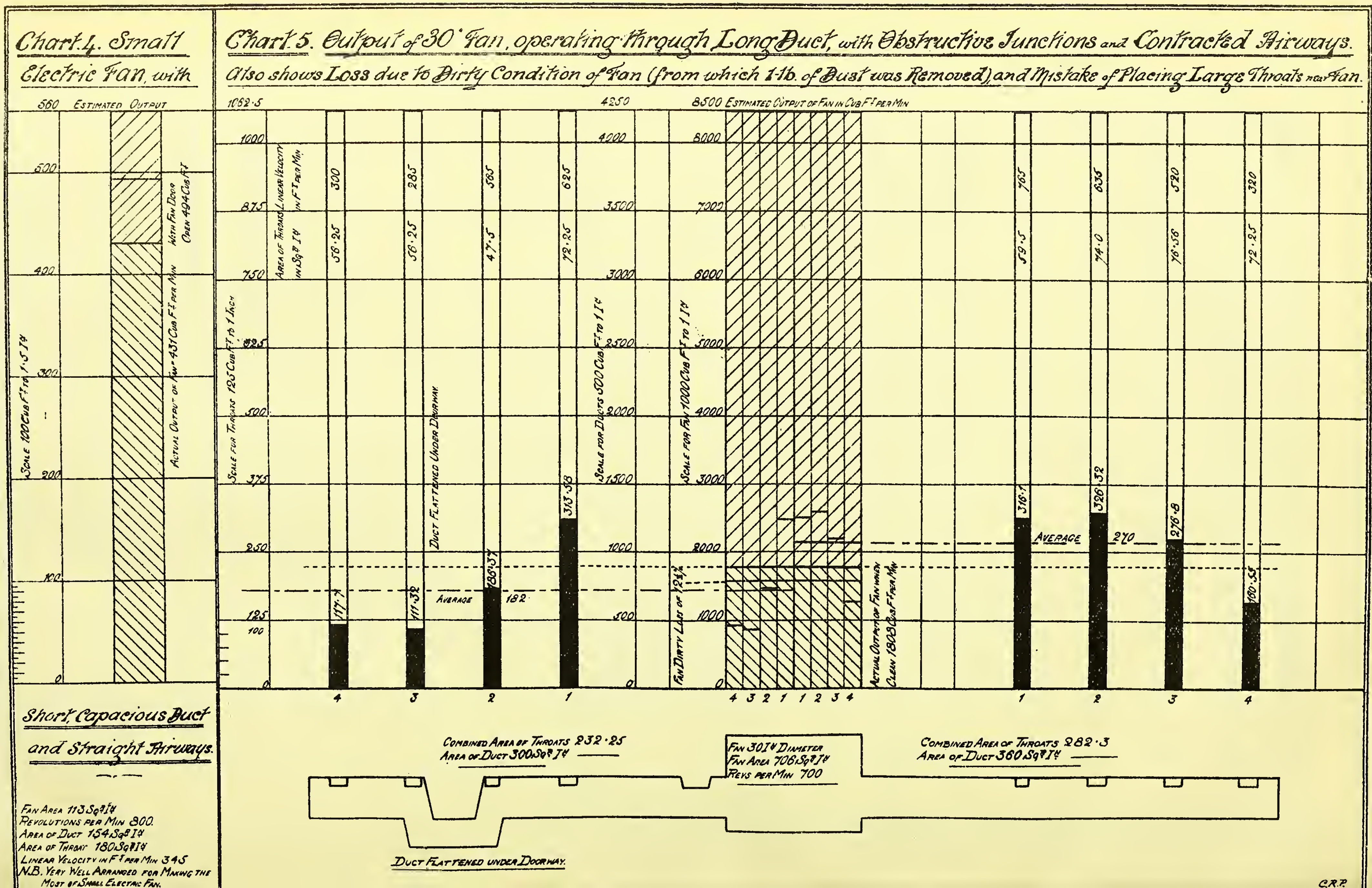
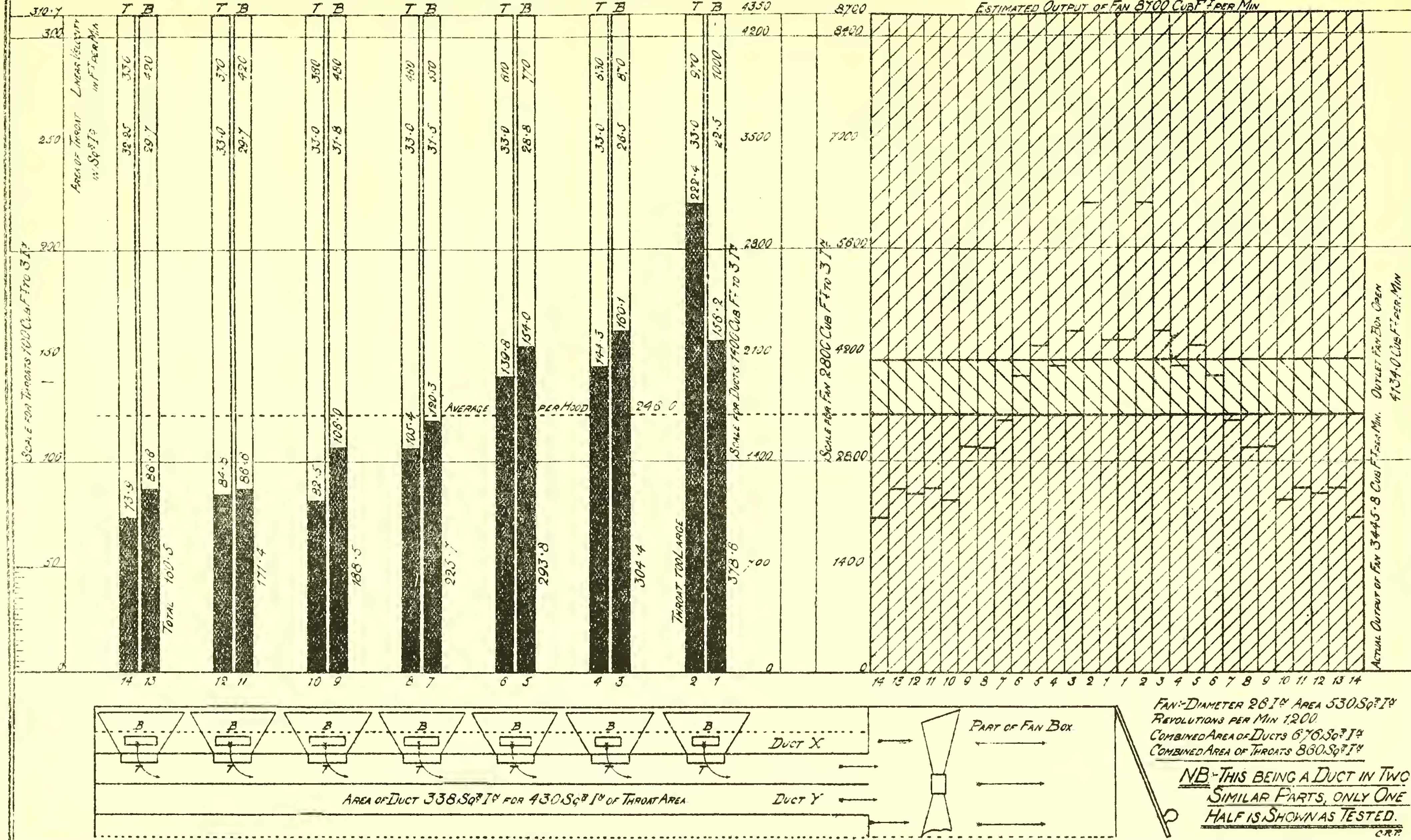


Chart 4. Small Electric Fan, with Short, Capacious Duct and Straight Airways.
560 Estimated Output
With Fan Door Open 494 Cub Ft
Actual Output of Fan 431 Cub Ft per Min
Scale 100 Cub Ft to 1·5 In
Fan Area 113 Sq In
Revolutions per Min 800.
Area of Duct 154 Sq In
Area of Throat 180 Sq In
Linear Velocity in Ft per Min 345
N.B. Very Well Arranged for Making the Most of Small Electric Fan.
Chart 5. Output of 30" Fan, operating through Long Duct, with Obstructive Junctions and Contracted Airways.
Also shows Loss due to Dirty Condition of Fan (from which 1 lb. of Dust was Removed), and Mistake of Placing Large Throats near Fan.
8500 Estimated Output of Fan in Cub Ft per Min
Area of Throats in Sq In
Linear Velocity in Ft per Min
Scale for Throats 125 Cub Ft to 1 Inch
Scale for Ducts 500 Cub Ft to 1 In
Scale for Fan 1000 Cub Ft to 1 In
Fan Dirty Loss of 12½%
Actual Output of Fan when Clean 1808 Cub Ft per Min
Duct Flattened Under Doorway
Average 182
Average 270
Combined Area of Throats 232·25
Area of Duct 300 Sq In
Fan 30 In Diameter
Fan Area 706 Sq In
Revs per Min 700
Combined Area of Throats 282·3
Area of Duct 360 Sq In
Duct Flattened under Doorway.
C.R.P.

Chart 6:- showing Approximate Output of a 26" High-speed Propeller Fan exhausting through Two Straight and Capacious (Parallel) Ducts with Free Inlets: but Outlets baffled by Flat Surface of Outer Fan Box (20% Increase on Relief). Graduation of Throats imperfect and Suction Unequalized.



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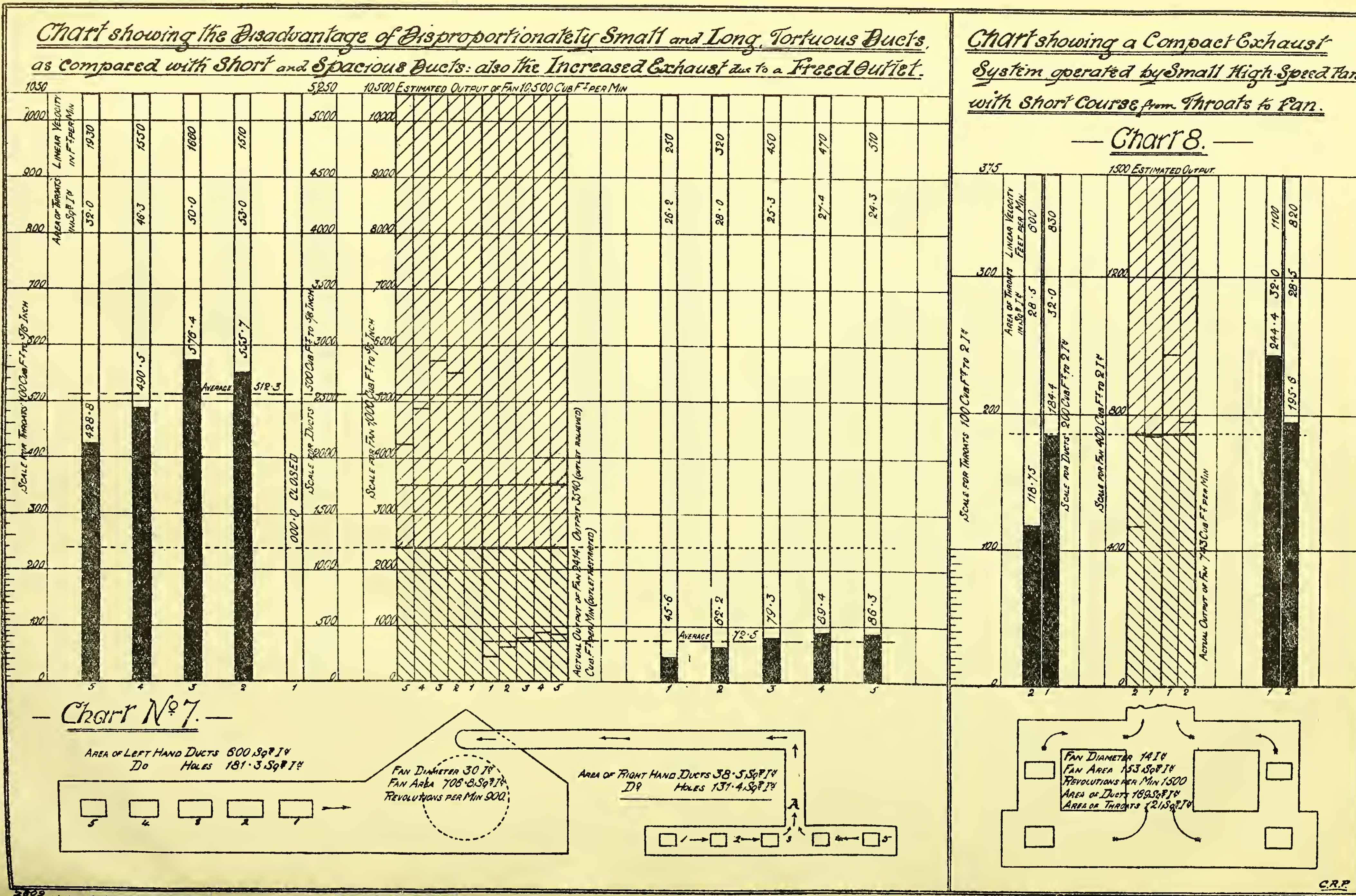
Chart showing the Disadvantage of Disproportionately Small and Long, Tortuous Ducts, as Compared with Short and Spacious Ducts: also the Increased Exhaust due to a Freed Outlet.
10500 Estimated Output of Fan 10.500 Cub Ft per Min
Linear Velocity in Ft per Min
Area of Throats in Sq In
Scale for Throats 100 Cub Ft to 5/8 Inch
Scale for Ducts 500 Cub Ft to 5/8 Inch
Scale for Fan 1000 Cub Ft to 5/8 Inch
000·0 Closed
Average 512·3
Average 72·5
Actual Output of Fan 2414 Cub Ft per Min (Outlet Restricted)
Output 3540 (Outlet Relieved)
– Chart No 7. –
Area of Left Hand Ducts 600 Sq In
Do Holes 181·3 Sq In
Fan Diameter 30 In
Fan Area 706·8 Sq In
Revolutions per Min 900
Area of Right Hand Ducts 38·5 Sq In
Do Holes 131·4 Sq In
Chart showing a Compact Exhaust System operated by Small High-Speed Fan. with Short Course from Throats to Fan.
– Chart 8. –
1500 Estimated Output
Linear Velocity Feet per Min
Area of Throats in Sq In
Scale for Throats 100 Cub Ft to 2 In
Scale for Ducts 200 Cub Ft to 2 In
Scale for Fan 400 Cub Ft to 2 In
Actual Output of Fan 743 Cub Ft per Min
Fan Diameter 14 In
Fan Area 153 Sq In
Revolutions per Min 1500
Area of Ducts 189 Sq In
Area of Throats 121 Sq In
C.R.P.
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PLATE 6.

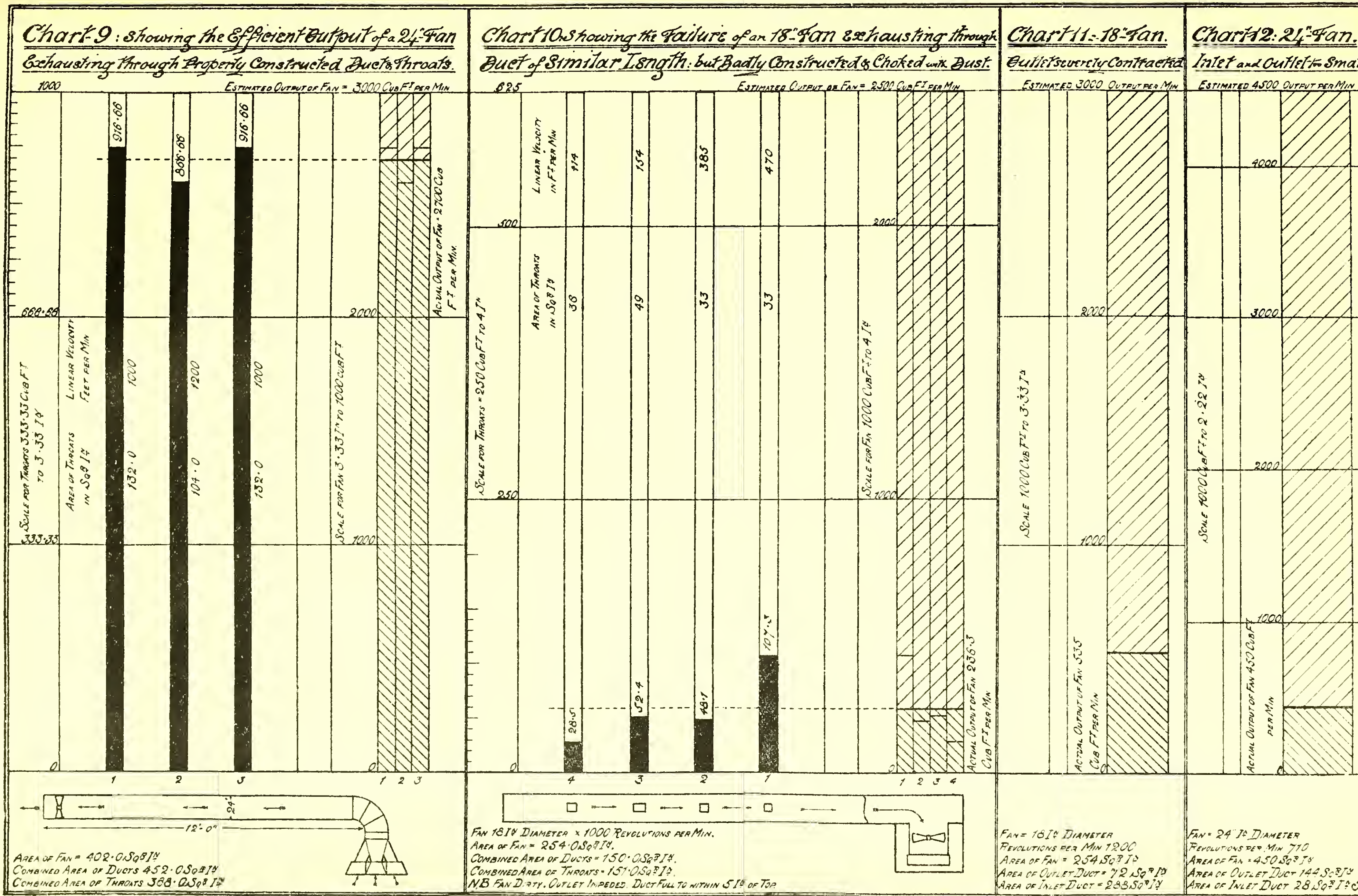
Chart 9: showing the Efficient Output of a 24" Fan Exhausting through Properly Constructed Ducts & Throats.
Estimated Output of Fan = 3000 Cub Ft per Min
1000
666·66
333·33
0
Scale for Throats 333·33 Cub Ft to 3·33 In
Area of Throats in Sq In
Linear Velocity Feet per Min
916·66
866·66
916·66
1000
1200
1000
132·0
104·0
132·0
1 2 3
Scale for Fan 3·33 In to 1000 Cub Ft
2000
1000
0
Actual Output of Fan = 2700 Cub Ft per Min
1 2 3
24"
12'-0"
Area of Fan = 402·0 Sq In
Combined Area of Ducts 452·0 Sq In
Combined Area of Throats 388·0 Sq In
Chart 10 Showing the Failure of an 18" Fan Exhausting through Duct of Similar Length: but Badly Constructed & Choked with Dust.
Estimated Output of Fan = 2500 Cub Ft per Min
625
500
250
0
Scale for Throats = 250 Cub Ft to 4 In
Linear Velocity in Ft per Min
Area of Throats in Sq In
414
154
385
470
38
49
33
33
28·5
52·4
48·1
107·3
4 3 2 1
Scale for Fan 1000 Cub Ft to 4 In
2000
1000
0
Actual Output of Fan 236·3 Cub Ft per Min
1 2 3 4
Fan 18 In Diameter × 1000 Revolutions per Min.
Area of Fan = 254·0 Sq In.
Combined Area of Ducts = 150·0 Sq In.
Combined Area of Throats = 151·0 Sq In.
N.B. Fan Dirty. Outlet Impeded. Duct Full to within 5 In of Top.
Chart 11:- 18" Fan.
Outlet severely Contracted
Estimated 3000 Output per Min
2000
1000
0
Scale 1000 Cub Ft to 3·33 In
Actual Output of Fan 535 Cub Ft per Min
Fan = 18 In Diameter
Revolutions per Min 1200
Area of Fan = 254 Sq In
Area of Outlet Duct = 72 Sq In
Area of Inlet Duct = 288 Sq In
Chart 12: 24" Fan.
Inlet and Outlet too Small.
Estimated 4500 Output per Min
4000
3000
2000
1000
0
Scale 1000 Cub Ft to 2·22 In
Actual Output of Fan 450 Cub Ft per Min
Fan = 24 In Diameter
Revolutions per Min 710
Area of Fan = 450 Sq In
Area of Outlet Duct 144 Sq In
Area of Inlet Duct 28 Sq In
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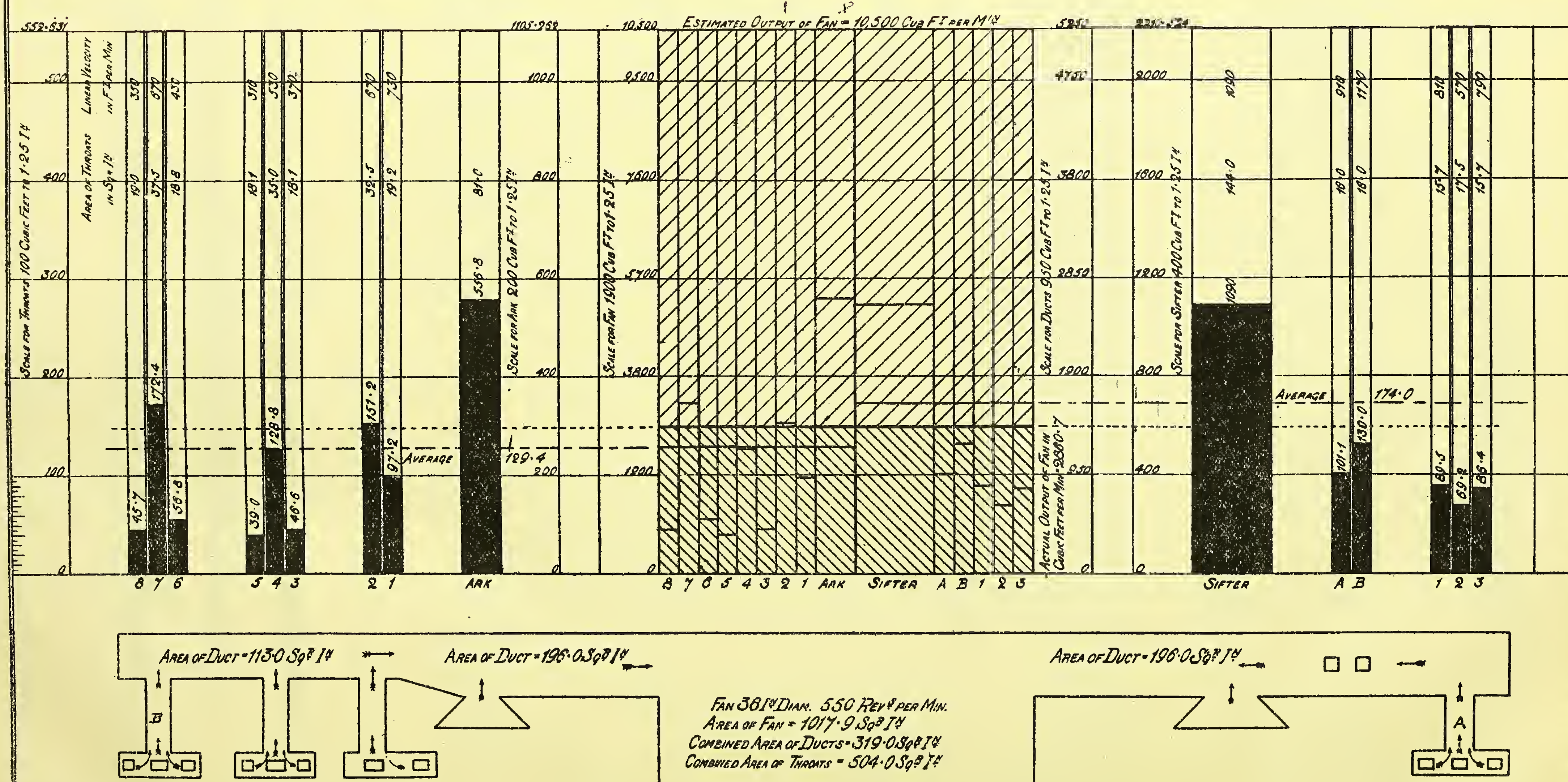
Chart 13: showing Approximate Output of 36" Exhaust Propeller Fan, operating through Long Tortuous Ducts with many Abrupt Turns: Large Throats near Fan and Small Throats at a distance. Efficiency also Lessened by Dirty Condition of Fan and Small Outlet.



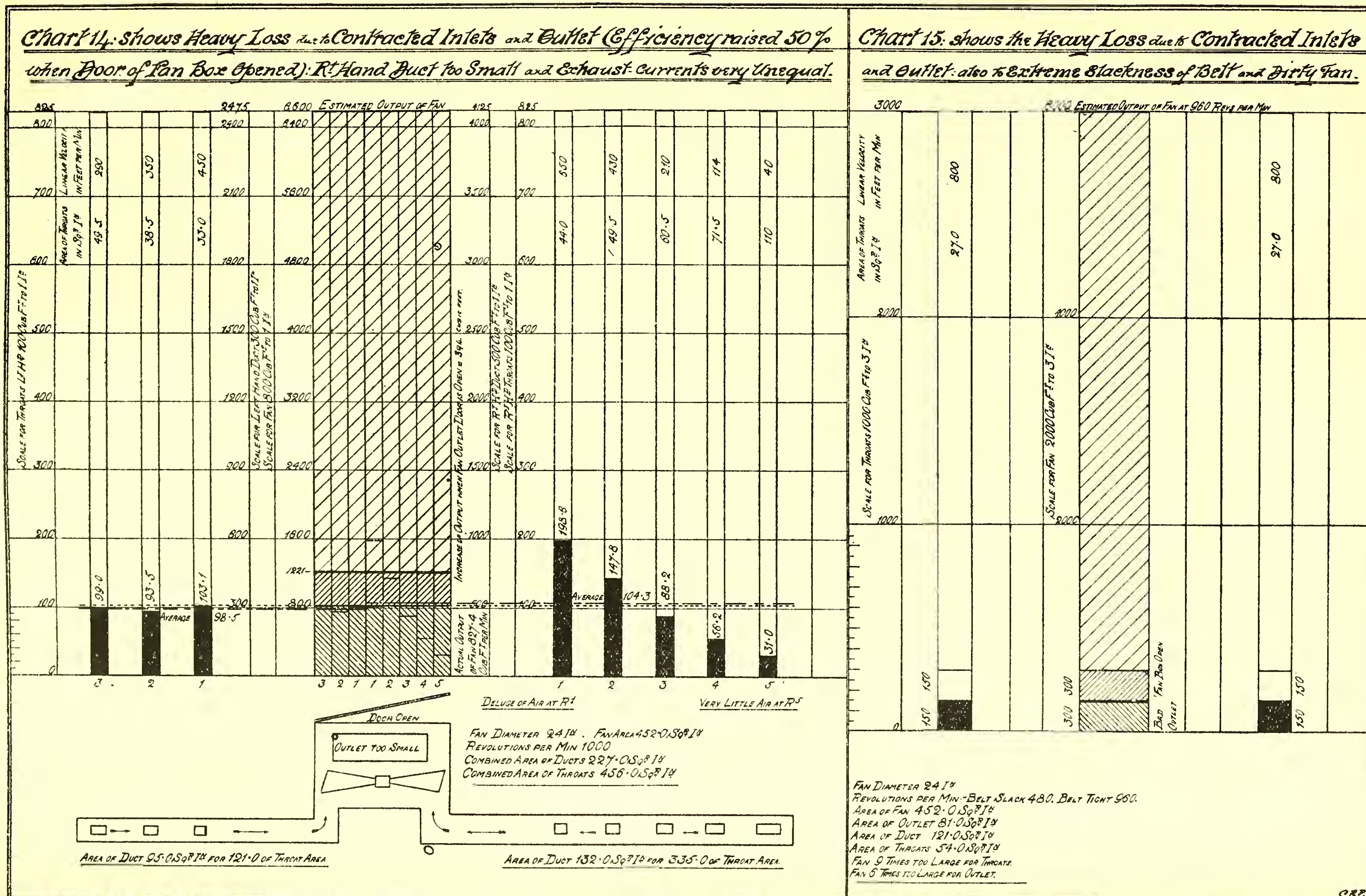


Chart 14: shows Heavy Loss due to Contracted Inlets and Outlet (Efficiency raised 50% when Door of Fan Box Opened): Rt Hand Duct too Small and Exhaust currents very Unequal.

Chart 15: shows the Heavy Loss due to Contracted Inlets and Outlet: also to Extreme Slackness of Belt and Dirty Fan.

PLATE. 9.

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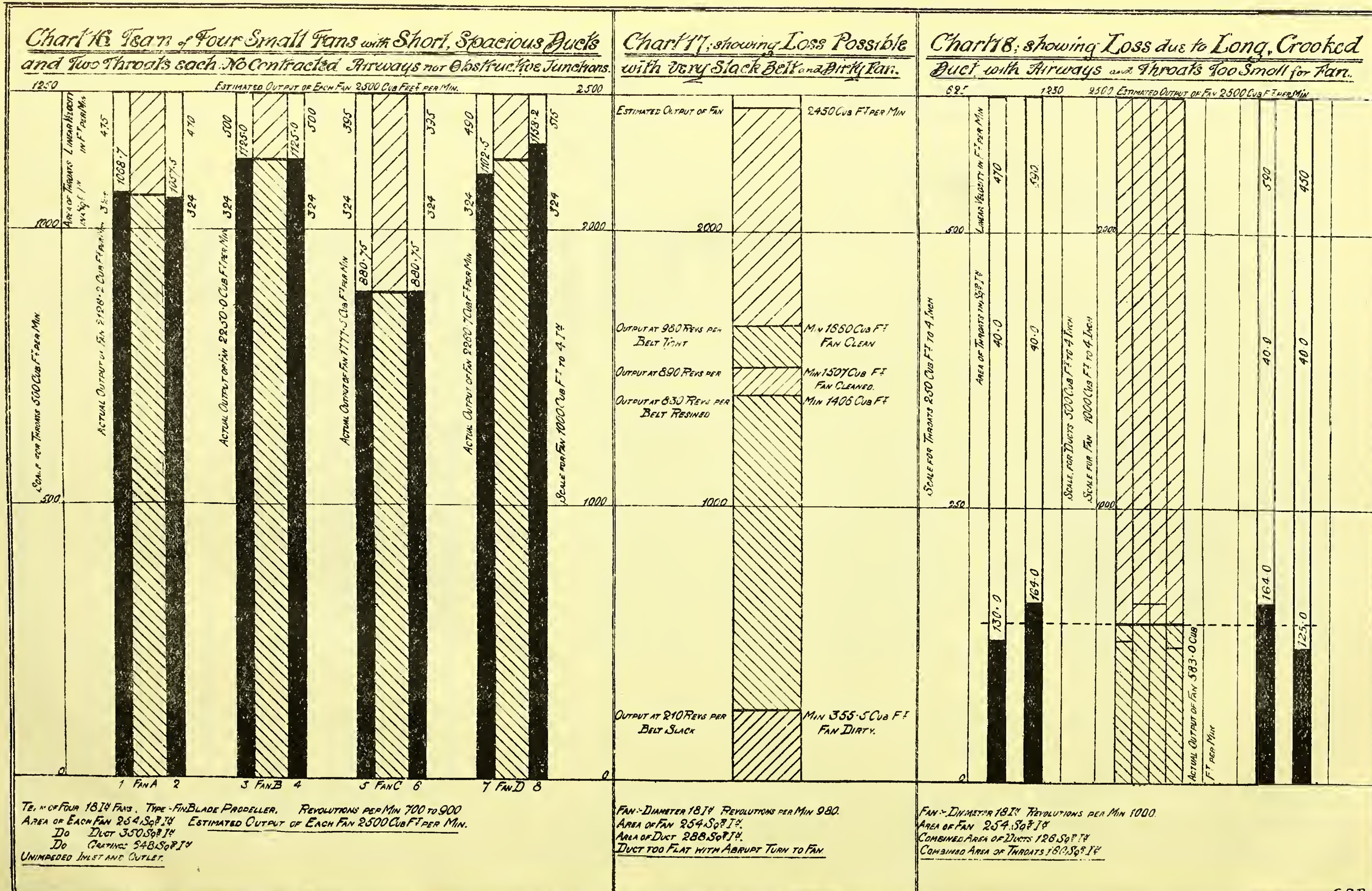

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APPENDIX XLIX.

PART I.

REPORT ON AN INVESTIGATION OF THE AIR OF WORK-PLACES IN POTTERIES. By G. ELMHIRST DUCKERING, Esq., one of H.M. Inspectors of Factories.

A short time was spent in visiting factories with members of the Committee. It at once became obvious that in many instances at least the amount of dust in the air could only be small, and that an apparatus of considerable delicacy was necessary for its estimation. Mr. Vernon Harcourt kindly obtained permission for me to make use of the laboratory at Christ Church, Oxford, in order to devise such an apparatus. The form finally adopted included:—

(*a*) A filter for separating the dust from air ; (*b*) a meter for measuring the volume of air from which the dust was separated ; (*c*) an aspirator.

The filter took the form of a small weighing bottle having a ground glass stopper, through which passed two tubes, one for admission and the other for exit of air. The former terminated in an inverted thistle funnel which was filled with cotton wool, the constriction in the lower part of the funnel holding the wool firmly to the inlet of the funnel. This form was adopted because it had been found almost impossible to prevent passage of air between the glass and cotton wool in a tube. In the form adopted this was entirely prevented, and all the dust collected in a small disc of wool not more than an eighth of an inch in thickness. In order to prevent loss of particles of the wool the whole of the funnel was covered with a cap of silk fastened by being tied round at the constrictions with thread. The filters were made in sets of three, as shown in the accompanying sketch. The three filter bottles were of the same size and general arrangement. For convenience in drying, however, bottle I. had the inlet tube cut off about half an inch from the stopper, and into it was made to fit by means of a ground glass joint a bent funnel (it was not deemed advisable to have a vertical inlet, as particles dislodged from beams above might fall into such an opening). The outlet from bottle I. was made to fit by means of a ground glass joint into the inlet of both bottle II and bottle III, the last two bottles being of exactly the same shape and size. The inlet and outlet tubes of all the bottles were fitted with ground glass stoppers, and rubber rings were slipped over the bottles and stoppers so as to hold the latter firmly. They were carried in a small box having four compartments, in each of which one bottle fitted. Holes were bored in the boxes, through which the inlet and outlet tubes of the filters projected during an experiment. These were closed by metal discs when not in use. In this form the apparatus was found most convenient for use, and there was no danger of loss of dust during transportation after an experiment. One filter only was used during an experiment, but three were dried together.

The volume of air filtered was measured by causing it to pass through an accurate experimental gas meter, the inlet of which was connected with the outlet of the filter by means of red rubber pressure tubing.

Passage of air through filter and meter was caused by means of water passing through a Bunsen aspirating pump attached to a tap and connected with the outlet of the meter by pressure tubing.

It was found impossible to dry the filters in the steam oven in the ordinary way. Hence a method of desiccation in a current of dry air with simultaneous heating was devised. The inlet of the first of three filters to be dried was connected to the outlet of another filter fitted up in the same way as for experiment, and the inlet of this filter (the guard filter) was attached to the outlet of a series of eight bulbs containing concentrated sulphuric acid, in such a way that all the four filters could lie on the bottom of the steam oven. The outlet tube of the last (fourth) filter was connected by glass tubing to a Winkler worm containing concentrated sulphuric acid, which in turn was connected to an aspirating pump. Interposed between the sulphuric acid bulbs and the filters, and also between the filters and the Winkler worm, were large glass Kjeldahl bulbs in order to prevent the possibility of sulphuric acid reaching the filters. On commencing aspiration, air passed through the sulphuric acid in the drying apparatus and was thus freed from moisture, then through the guard filter where it was freed from dust, and then through each of the three filters in turn, and then through the Winkler worm containing sulphuric acid, the four filters being at the same time heated in the steam bath. The tubes connecting the drying apparatus with the filters, and the filters with the Winkler worm, were made to pass through a small space at the bottom of the oven door, so that except for this small opening the oven was closed in the ordinary way. By making the cotton wool in the first or guard filter very tight a considerable reduction of pressure was obtained, and hence drying was in a partial vacuum.

Several experiments were carried out to ascertain the time required for drying, and it was found that constant weight was attained in $1\frac{1}{2}$ hours, three successive experiments giving the following results:—

	Weight after $1\frac{1}{2}$ hours' drying.	Weight after $2\frac{1}{2}$ hours' further drying.	Difference.
(1)	0·5030 grams.	0·5032 grams.	+ 0·0002 grams.
(2)	2·8146 ,,	2·8146 ,,	nil ,,
(3)	2·1874 ,,	2·1872 ,,	— 0·0002 ,,

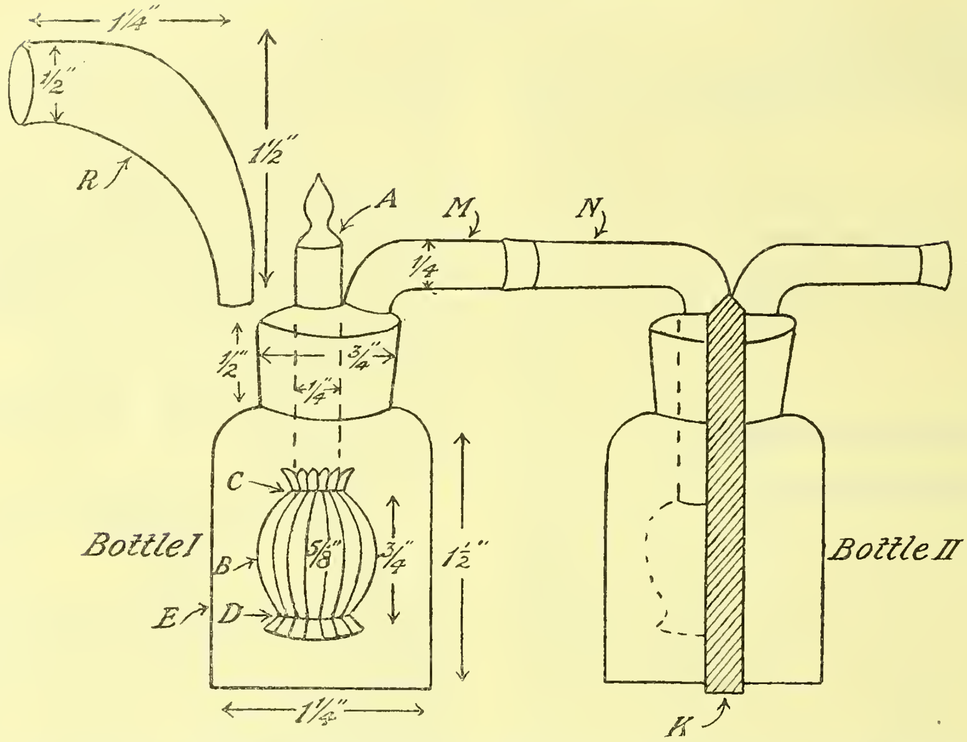
In order to ensure perfect desiccation, however, at least $2\frac{1}{2}$ hours' drying were allowed in all cases.

In order to test the accuracy of the method the following plan was adopted. In a small and light Wolff's bottle was placed a quantity of very finely ground red dusting lake. The intense red of this powder enabled its course to be readily followed, and it was found that even a small trace produced a visible red in water. Into one of the necks of the Wolff's bottle was ground a tube acting as a stopper and reaching nearly to the bottom of the bottle. The part of this tube projecting above the neck was bent at an obtuse angle, and served for the air inlet. It was attached to the outlet of a guard filter. Into the other neck of the Wolff's bottle was ground a tube terminating just inside the neck, having the part outside bent at an acute angle, which served as the air outlet. The free end of this tube was ground into the inlet of a filter made up as described above. This method of arrangement allowed of the Wolff's bottle being tilted so as to bring the heap of red dust in it just under the end of the long air inlet tube. The outlet of the filter was attached to the inlet of a washing vessel containing water, the outlet of which was connected to an aspirating pump. On allowing water to flow through the aspirating pump air was caused to pass at a fairly rapid rate through the apparatus, first through the guard filter, in order to free it from atmospheric dust, and then into the Wolff's bottle, where it entered through the long tube, and, impinging on the heap of dust just below, became charged with the red dust, which passed over and was filtered off in the filter, the air passing on through the water in the washing vessel. The dust tended to collect in small quantity in the bent tube between the Wolff's bottle and the filter, but by gently tapping it while the air was passing, this could be prevented. The Wolff's bottle containing dust, with the tubes in position, and the filter, were weighed before and after the experiment. No trace of the red dust could be observed in any part of the apparatus beyond the filter, and there was no colour to be observed in the water in the washing vessel. Fair agreement was obtained generally between the loss of weight in the Wolff's bottle and the gain in the filter. Two successive experiments gave the following results: —

	Weight before Expmnt. Grams.	Weight after Expmnt. Grams.	Difference. Grams.
(1) Wolff's bottle -	53·6000	53·3318	Loss 0·2682
Filter - -	25·0070	25·2760	Gain 0·2690
Volume of air aspirated = 5·8 cubic feet.		Gain on expmnt. 0·0008 = 0·29% on dust lost from Wolff's bottle.	
(2) Wolff's bottle -	53·3291	53·2746	Loss 0·0545
Filter - -	24·8268	24·8818	Gain 0·0550
Volume of air aspirated = 9·022 cubic feet.		Gain on expmnt. ·0005 = 0·91% on dust lost from Wolff's bottle.	

FIGURE I.

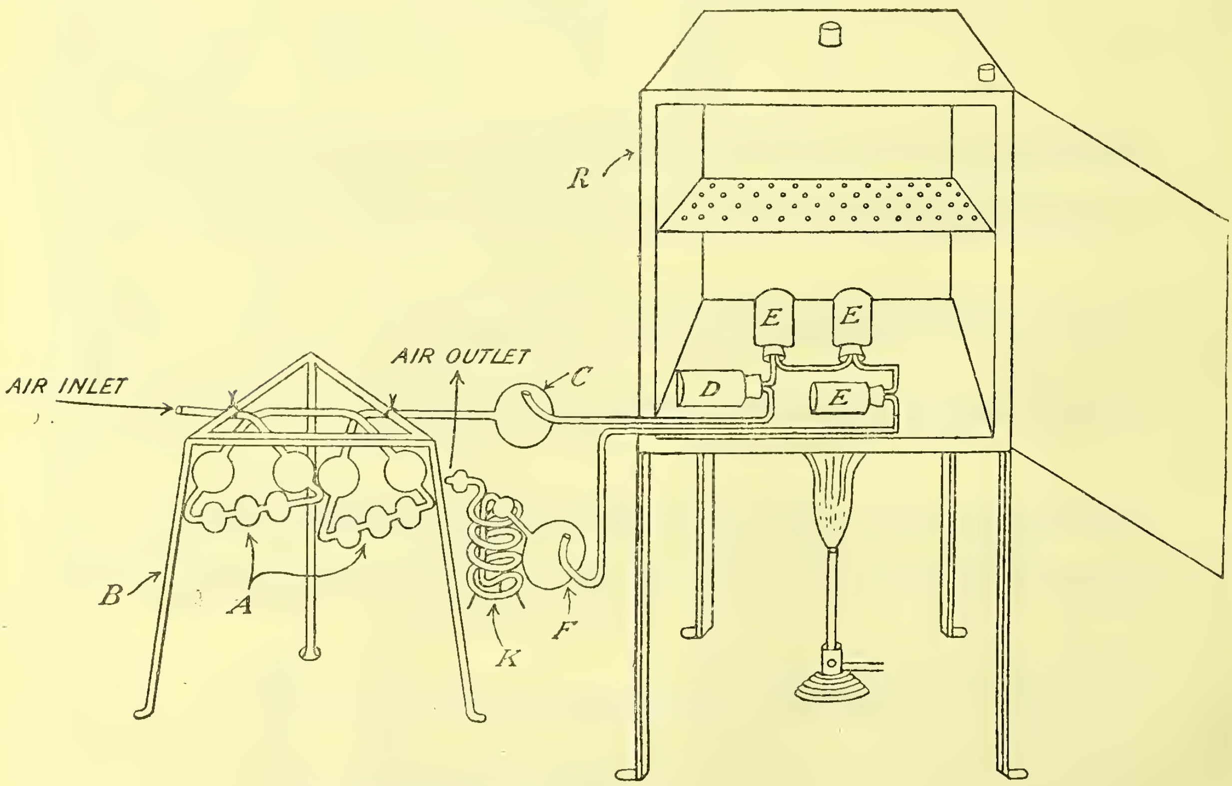
SKETCH OF FILTER BOTTLES, IN WHICH DUST IS SEPARATED FROM AIR.



A.—Air inlet tube, provided with a stopper, into which is fitted the bent funnel R during a dust collection.
B.—Inverted funnel, in which A terminates, filled with cotton wool and covered with a silk cap tied by thread at C and D.
E.—Filter bottle.
M.—Air outlet, connected by rubber tubing to the meter in a dust collection, and fitting into the air inlet N of a second filter bottle for drying.
K.—Rubber band holding stopper firmly in bottle.

FIGURE II.

SKETCH SHOWING METHOD OF DRYING.



A.—Sulphuric acid drying bulbs supported on tripod B.
C.—Guard bulb between H_2SO_4 and filters.
D.—Guard filter to filter off atmospheric dust in dried air.
E, E, E.—Filters in process of being dried lying on bottom of steam oven R.
F.—Guard bulb between filters and sulphuric acid worm.
K.—Winkler worm, containing concentrated H_2SO_4, the outlet of which was connected to an aspirating pump.

Allowing for the great difficulty of such an experiment, these results appeared to show that the method was sufficiently accurate.

It was found necessary to ensure absolutely that there was no leakage in the apparatus when drying, the admission of even a small amount of undried and unfiltered air causing variable results.

Experiments were also carried out to ascertain if varying states of humidity of the atmosphere affected the filters. In order to do this, air was caused to pass, first through a guard filter, then through a washing vessel containing slightly warmed water, and then through a weighed filter. The air was thus saturated with moisture. In order to ascertain the effect of dry atmosphere the air was caused to pass first through a guard filter, then through a washing vessel containing concentrated sulphuric acid, and then through a weighed filter. The filters were in each case allowed to stand for twenty-four hours before being dried and weighed. No appreciable difference could be observed, the results of two experiments being as follows:—

	Dry air.	Moist air.
Weight before experiment	=0·4730 grams	2·4070 grams
„ after „	=0·4729 „	2·4068 „
Loss in weight	=0·0001 „	0·0002 „
Volume of air aspirated	=4·0 cubic ft.	4·04 cubic ft.

In the dust determinations made in factories the filter was always placed at the breathing level. Before drying, the filters were always carefully wiped, but being enclosed in a box during the determination there was very rarely any dust on them. They were then dried for 2½ hours, again wiped with a clean linen handkerchief with the stoppers in, again placed in the oven for ten minutes, and allowed to stand in the desiccator for thirty minutes before weighing. In order to avoid any error due to change in the glass an unfilled filter was always used as counterpoise, and was treated in exactly the same way as the filters to be weighed.

Investigations in Work-places.

The results of the investigation in work-places, so far as they can be expressed in the form of figures, are given in the following tables.

Table A gives those obtained in rooms where lead is not used. Column 2 shows the kind of ware in course of manufacture in the rooms in which the determinations were made, and column 3 the actual process being carried on at the point at which the dust was collected.

In many cases other work was being done in the same room, frequently in near proximity to the point at which the filter was placed. Thus, in tile-making, where the process given in column 3 is pressing, there was generally an assistant doing fettling close by; and, conversely, where fettling is the process given, pressing was also being done near the fettler. In many cases, as in pressing and fettling of tiles, there are two or more dusty processes carried on together, and it is therefore impossible to estimate exactly the effects of each, *e.g.*, exhaust is sometimes applied to the presses but rarely to the process of fettling, and hence no doubt the dust produced by the fettler affects the result of a determination of dust in the air at the breathing point of a pressworker.

Column 4 shows the worker near whose breathing point the determination was made, and therefore the one chiefly affected by the dust shown to be present in the air, and in column 5 is given the amount (in milligrams) of dust per 1,000 cubic feet of air found at the breathing point of this worker. In column 6 is given an estimate (based on the statements of the workers named in column 4) of the daily period during which the dusty air is breathed, and in column 7 an estimate of the quantity (in milligrams) of dust breathed daily. In order to obtain this, the average quantity of air inspired per hour is taken as 18 cubic feet; this number, multiplied by the number of hours spent daily in the dusty air and by the number of milligrams of dust present in one cubic foot of air, gives the figure shown in column 7.

In column 8 is given the volume of air extracted per minute by means of exhaust, locally applied, from a point at or near that at which dust is produced by the worker named in column 4. In order to obtain this, anemometer tests were made of the velocity of the current of air in the air inlet to the duct, and the average of these readings in feet per minute multiplied by the area in square feet of the inlet. The product is the volume of air in cubic feet per minute which is removed in the vicinity of the point of origin of the dust.

Under the head of general ventilation, columns 9 to 17 show those factors which modify the proportion of dust in the air. The first of these factors is the number of people working in the room (columns 9 and 10), and the second is the cubic space provided for each person (column 11).

In this connection it may be pointed out that it is doubtful if cubic space per person has, in itself, any very definite effect in reducing the proportion of dust in the air at the breathing level of workers. A much more important factor is the amount of floor space per person, especially where women are working. A large cubic space may be provided by increasing the height of a room. In such a case the large space above the heads of the workers would act as a dust reservoir, and, as dust always tends to fall vertically, would maintain a constant supply into the comparatively small space from which the workers' air supply is taken. In the case of a room where the floor space per person is ample, not only is less dust produced by the movements of the persons in the room, but that which has entered the air has more space in which to settle without coming in contact with the workers. It has also the opportunity of settling much more quickly owing to the smaller motion of the air in the lower levels.

In columns 12, 13 and 14, are given the total areas of all inlets for fresh air, open during the time occupied by the determinations, in such a way as to show what through ventilation was possible. Probably properly arranged through ventilation has considerable effect in reducing the proportion of dust in the air, but openings in one wall only have apparently little effect.

Column 15 shows the volume of air in cubic feet removed from the room per person per minute by means of exhaust applied locally at points at which dust is produced. This column shows for the whole of the room that which column 8 shows for the individual worker at the point at which dust in the air was determined. In some cases an open fire was burning in the room, and, as this would have a considerable ventilating effect, such cases are distinguished by an asterisk placed in column 15.

Columns 16 and 17 show the temperature in the room and in the outside air respectively. Ventilation of course, largely depends on the difference between these temperatures.

In column 18 is given the material composing the floors of those rooms in which dust determinations were made; and in column 20 are recorded any circumstances, bearing on the dust figures, and other noteworthy points.

The general arrangement of the data is such as to bring comparable determinations together. The numbers by which they are distinguished in columns 1 and 19 are given for convenience of reference only. They do not indicate the order in which the determinations were made.

Table B is similar to table A, and shows the results of the investigation in rooms where lead is used. It has therefore additional columns showing the quantity of lead present per 1,000 cubic feet of air, the proportion of lead in the dust, and an estimate of the quantity of lead inhaled daily.

Table C shows the chief results of the investigation, viz., the quantities of dust and lead found in a stated volume of air, in such a way as to enable a comparison of the dangers of the respective processes to be made easily. Exceptional cases, in the results on which the data given in table C are based, are either excluded or referred to in a footnote to the table. Thus determinations of dust in factories where leadless or low solubility glaze is used are excluded.

Tables D and *E* show details of temperature (wet and dry bulb readings) in the rooms in which determinations were made, and also those details of aspiration on which the figures given in tables A and B are based.

Table F shows results of dust determinations in the air of rooms not generally regarded as dusty, these being made for purposes of comparison.

Table G gives results of analyses of a number of samples of dust which had become deposited in the course of time at various points in rooms in which determinations of dust in the air were made.

Tabular Statement of Results of Investigation.

TABLE A.—Rooms in which no Lead is used.

The determinations were generally made at the breathing point, *i.e.*, within a few inches of the face of the worker. Where the determination was made in the centre of the room, the filter was placed at the ordinary breathing level.

No of determination.	Manufacture.	Process.	Worker at whose breathing level dust was determined.	Dust. Dust present per 1,000 cubic feet of air. (mgms.)	Dust. Estimated time during which dust is inhaled daily. (hrs.)	Dust. Dust estimated to be inhaled per working day. (mgms.)	Air extracted per minute by local exhaust at the point at which dust is produced by the worker named in column 4. (c. ft.)	General Ventilation. Persons at work in the room. M.	General Ventilation. Persons at work in the room. F.	General Ventilation. Space per person (c. ft.)	General Ventilation. Area of fresh air inlets open. On one side of room. (sq ft.)	General Ventilation. Area of fresh air inlets open. On opposite side of room (sq. ft.)	General Ventilation. Area of fresh air inlets open. In roof. (sq. ft.)	General Ventilation. Air extracted by local exhaust per person per minute from the whole of the room. (c. ft.)	General Ventilation. Temperature. In room. Fah.	General Ventilation. Temperature. In Outside air. Fah.	Material of floors.	No. of determination.	Remarks.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
1	Floor tiles	Pressing	Press Worker	1,380	8¼	205	Nil	—	11	852	4·0	Nil	0·4	Nil*	52	50	Wood	1	1 and 2 made in same position with same girl working press. In 2 there were four girls less working, work was slower and difference between inside and outside temperatures was greater than in 1. Floor was clean in 2 but not in 1.
2	"	"	"	1,155	8¼	172	"	—	7	1,337	4·0	"	0·4	" *	50	44	"	2	
3	"	"	"	1,711	8¼	254	"	—	8	681	0·2	"	1·2	" *	48	37	"	3	Cubic space smaller, area of air inlets smaller and work more energetic than in 1 and 2.
4	Ornamental tiles	"	"	1,580	9½	270	"	9	12	515	Large	Large	Nil	"	58	49	Brick	4	4 and 5 made in same position and with same presser and fettler working. Exhaust was in operation in 5 but not in 4. Dust inhaled by presser when exhaust in operation probably largely produced by fettler who was subject of determination 9.
5	"	"	"	750	9½	128	316	7	10	636	"	"	"	106	60	50	"	5	
6	"	"	"	543	8	78	156	18	12	515	5·0	Nil	Small	103	61	44	Tiles	6	Comparable with 5 but exhaust better applied. Method of work such as to draw dust from fettler (*cf.* 12) across presser.
7	"	"	"	517	7	65	72	1	27	404	Nil	"	Nil	112	64	—	"	7	7 and 8 made during pressing of small tiles. In 7 application of exhaust such as to draw dust from fettler along bench to presser, but in 8 exhaust tended to draw dust to back of bench.
8	"	"	"	463	9½	79	71	—	23	330	1·2	"	"	70	59	55	Brick	8	
9	"	Fettling	Fettler	4,550	9½	768	Nil	7	10	636	Large	Large	"	Nil	60	50	"	9	Large tiles. No exhaust in operation. Fettler was working near press at which 4 and 5 were made.
10	"	"	"	1,233	9½	211	"	—	9	846	1·2	Nil	"	"	52	48	"	10	Small tiles. Exhaust not in operation. Same position as 11, same fettler working.
11	"	"	"	492	9½	84	"	—	23	330	1·2	"	"	70	61	54	"	11	Same point as 10. Exhaust behind presses in operation and so arranged as to remove some of dust produced by fettler.
12	"	"	"	600	8	86	"	18	12	515	5·0	"	Small	103	60	44	Tiles	12	Process similar to that in 9, but exhaust, applied to pressing only, in operation.
13	"	"	"	250	8	36	67	18	12	515	5·0	"	"	103	61	44	"	13	Made at bench next to that at which 12 was made, but exhaust applied to fettling as well as to pressing.
14	Floor tiles	(Centre of room)	Passing workers only	815	8¼	121	Nil	—	7	1,337	4·0	"	0·4	Nil*	52	44	Wood	14	Same shop as 1 and 2. Similar to 15.
15	"	"	"	977	8¼	145	"	—	8	681	0·2	"	1·2	" *	51	40	"	15	Same room as 3.
16	Ornamental tiles	"	"	1,343	9½	230	"	—	7	1,087	1·2	"	Nil	"	53	48	Brick	16	16 and 17 made in same position. Exhaust at presses in operation in 17, but not in 16. No exhaust to fettling. Six placers were removing saggers during 1¼ hours and constantly passing filter in 16.
17	"	"	"	173	9½	30	"	—	15	407	1·2	"	"	107	51	45	"	17	
18	China	Potters' shop	Potters and assistants	223	9	36	"	4	2	661	22·0	"	"	Nil	75	47	"	18	Ventilation bad. Only air inlet was a door at extreme end of side of shop. Only ventilation from stoves was into room.
19	"	"	"	246	9½	42	"	11	9	618	0·5	0·5	"	"	67	38	"	19	Fine lofty room, but practically no ventilation. Centre of room taken up by stillage.
20	Earthenware	"	"	191	9	31	"	2	7	403	Nil	Nil	"	"	68	53	"	20	Practically no ventilation, but traffic small. Two-sided dobbins used in stoves.
21	"	"	"	450	9½	77	"	10	21	640	32·5	"	"	28	74	50	Wood	21	Badly ventilated shop. Traffic large. Four-armed dobbins used in stoves and strong current of hot air issuing from openings.
22	"	"	"	115	8½	18	"	3	2	933	1·1	0·6	"	Nil	59	46	"	22	Ventilation deficient, but traffic small. Two-sided dobbins used in stoves.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
23	Earthenware	Potters' shop	Potters and assistants	62	9½	11	Nil	10	15	336	21·0	21·0	52·0	Nil	72	44	Brick	23	Long and very narrow shop with copious ventilation by open skylights. Four-armed dobbins used in stoves and current of hot air issuing from openings.
24	"	" and towing	"	100	9½	17	"	6	30	233	20·0	Nil	36·0	83	71	44	"	24	Similar to 23, but ventilation not quite so good and cubic space per person smaller. Towing done in same room. Traffic immense.
25	"	"	"	107	9½	18	"	6	30	233	20·0	"	36·0	83	77	44	"	25	Same shop as 24, but position of filter further from exhaust applied to towing.
26	"	Potters' shop	"	69	8½	10	"	2	—	823	Nil	"	Nil	Nil*	64	46	"	26	Small shop. Little traffic. Large fire burning.
27	"	Towing	Tower	300	8½	16	236	—	17	1,198	65·0	50·0	"	317	66	44	"	27	Large shop chiefly taken up by stillage in which there was much traffic. Floor very dusty.
28	"	"	"	300	9	49	1,350	—	6	720	0·5	0·2	"	1,552	57	44	"	28	Dust discharged by fan returned to room through air inlets, which were all on same side of room as discharge from fan.
29	"	"	"	339	9	53	286	1	7	1,091	1·3	21·0	"	224	67	44	Wood	29	Shop also used as a potter's shop. Much traffic.
30	"	Flat fettling	Fettler	256	7½	35	Nil	2	6	893	Nil	Nil	"	Nil	59	40	"	30	Shop used also as potter's shop. Traffic small. Sponging off with wet sponge occupied 2 hours 5 minutes of the 3¼ hours taken by the determination. Two-sided dobbins used in stoves.
31	China	Flat bedding and flinting	Bedder	485	9	79	"	4	—	Large	Large	Large	"	"	50	49	Brick	31	In sagger house. Strong through current of air caused by oven.
32	"	Hollow-ware placing	Placer	363	9	59	"	4	—	"	"	"	"	"	52	52	"	32	In sagger house. Strong through current of air caused by oven.
33	"	Bedding and placing	"	571	8½	87	"	19	—	576	30·0	30·0	3·0	"	57	47	"	33	Ventilation not so good as in 31 and 32. Man was doing both flat bedding and hollow-ware placing.
34	"	Biscuit drawing	Oven drawers	598	8½	91	"	3	—	—	Large	Large	Large	"	82 to 154	47	—	34	Strong current of air through oven.
35	"	Biscuit emptying	Emptiers	1,676	8½	257	"	2	—	Large	"	"	Nil	"	47	47	Brick	35	Biscuit emptied on stage at mouth of oven. Strong current of air passing over emptiers into oven.
36	"	"	"	2,385	5½	236	"	Varied	—	"	"	"	"	238	62	51	"	36	Biscuit emptied in sagger house. Ventilation bad.
37	"	Emptying flint from saggers	"	2,737	at intervals	—	"	1	—	"	"	"	"	Nil	—	—	"	37	Strong through current of air caused by oven.
38	"	Flint sifting	Sifter	206	9	33	535	1	—	2,096	"	"	"	535	46	46	"	38	Sifting machine well enclosed, but some dust caused by movement of flint boxes and some issued from doors of machine when opened.
39	"	"	"	125	9	20	535	1	—	2,096	"	"	"	535	46	46	"	39	Made at different part of same machine as 38.
40	"	"	"	2,650	6	339	—	1	—	775	Nil	Nil	"	850	64	52	"	40	Sifting machine not enclosed and much dust produced at parts not affected by exhaust.
41	"	Flat knocking	Flat Knocker	980	9	158	—	1	—	2,096	Large	Large	"	535	52	52	"	41	41 and 42 were made at different working points at same machine which was well enclosed. Dust issued from doors of machine when opened and was also produced during transference of ware from machine cradle to baskets.
42	"	"	"	968	9	156	—	1	—	2,096	"	"	"	535	51	51	"	42	
43	"	"	"	16,600	½	149	Nil	Varied	—	Large	"	"	"	238	62	51	"	43	Pile of plates taken in the hands and shaken. No exhaust applied and no covered box in use.
44	"	China scouring	Scourers	300	9	49	"	—	6	1,520	25·0	23·0	"	75	58	44	"	44	44 and 45 made at different points in same biscuit warehouse where scouring is done by machine (Rumbler). Dust is produced in handling ware before scouring. 44 was made on same day as ware was drawn and 45 on day after. Flint was warmer and more dusty in 44 than 45.
45	"	"	"	275	9	45	"	1	4	1,824	25·0	23·0	"	75	57	52	"	45	
46	"	"	"	398	9½	68	585	—	11	1,144	3·0	Nil	"	205	50	43	Wood	46	Scouring by hand before good exhaust which drew dust produced in handling ware and by fine brushers (*cf.* 47) across scourers.
47	"	Fine brushing	Brushers	573	9½	98	21	—	7	1,800	3·0	"	"	322	48	37	"	47	Same shop as 46. Exhaust applied but overpowered by superior scouring exhaust.
48	Earthenware	Biscuit brushing	"	1,660	9	769	Nil	—	6	2,176	10·0	"	"	Nil	65	46	Brick	48	Workers covered with dust. No exhaust.

* An open fire was burning in these rooms.

Tabular Statement of Results of Investigation.

TABLE B.—Rooms in which Lead is used.

The determinations were generally made at the breathing point, *i.e.*, within a few inches of the face of the worker. Where the determination was made at a stillage, the filter was placed at the ordinary breathing level in the centre of the stillage gangway.

No. of determination.	Manufacture.	Process.	Worker at whose breathing level dust was determined.	Dust. Dust present per 1,000 cubic feet of air. Total (mgms.)	Dust. Dust present per 1,000 cubic feet of air. Lead (Pb) (mgms.)	Dust. Percentage of lead (Pb) in dust.	Dust. Estimated time during which dust is inhaled daily. (hrs.)	Dust. Dust estimated to be inhaled per working day. Total (mgms.)	Dust. Dust estimated to be inhaled per working day. Lead (Pb) (mgms.)	Air extracted per minute by local exhaust at the point at which dust is produced by the worker named in column 4. (c. ft.)	General Ventilation. Persons at work in the room. M.	General Ventilation. Persons at work in the room. F.	General Ventilation. Space per person. (c. ft.)	General Ventilation. Area of fresh air inlets open. On one side of room. (sq. ft.)	General Ventilation. Area of fresh air inlets open. On opposite side of room. (sq. ft.)	General Ventilation. Area of fresh air inlets open. In roof. (sq. ft.)	General Ventilation. Air extracted per person per minute by local exhaust from the whole of the room. (c. ft.)	General Ventilation. Temperature. In room. Fah.	General Ventilation. Temperature. In outside air. Fah.	Material of floors.	No. of determination.	Remarks.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
49	Earthenware	Dipping	Dipper and assistants	256	6·11	2·39	7½	35	0·82	Nil	4	—	315	Nil	Nil	Nil	Nil	91	43	Cement	49	No boards used. Ware placed direct on mangle. Current of air brought dust from biscuit brushing room.
50	"	"	"	100	3·33	3·33	7½	14	0·45	"	6	—	2,670	Large	Large	Large	"	67	49	"	50	No boards used. Ware placed direct on mangle. Powerful current of air from biscuit brushing room but no brushing being done.
51	"	"	"	40	5·00	12·50	7½	5	0·67	"	4	—	315	1·5	Nil.	Nil	"	100	—	"	51	No boards used. Ware placed direct on mangle. Dipping appliances clean. Strong current of air outward from mangle.
52	"	"	"	40	6·04	15·00	7½	5	0·82	"	4	—	315	1·5	"	"	"	100	—	"	52	Repeat of 51. Same remarks apply.
53	"	Drying by mangle	"	39	1·94	5·00	7½	5	0·26	"	4	—	315	1·5	"	"	"	100	—	"	53	Filter placed in current of air issuing from mangle. Same day and same mangle as in case of 51 and 52.
54	"	Dipping	"	238	17·79	7·42	7½	32	2·40	"	1	2	Large	Nil	"	"	* "	51	36	Brick	54	Very dirty boards in use. Work very rapid and much shaking of ware after dipping.
55	China	"	"	53	1·66	3·13	7½	7	0·22	"	1	—	2,827	"	"	"	Nil	58	52	"	55	55 and 56 were made at same point. Moderately dirty boards were in use but dipper had no assistant and hence work was very slow. In 56 ware cleaning was being done in same room but not in 55. Exhaust provided was bad. Results indicate that dust produced in cleaning may affect dipper.
56	"	"	"	117	3·33	2·85	7½	16	0·45	"	1	1	1,413	"	"	"	53	54	50	"	56	
57	"	"	"	118	11·17	9·50	8	17	1·61	"	4	—	735	1·0	"	"	106	47	36	"	57	57 and 58 made over same dipping tub. 57 on side on which dirty boards were placed, and 58 on opposite side of same tub. Current of air was such that neither side was much affected by dust from opposite side. Ware cleaning in same room during 58 but not during 57. Exhaust in operation at cleaning bench in both cases.
58	"	"	"	114	7·14	6·25	8	16	1·03	"	3	—	980	1·0	"	"	142	55	41	"	58	
59	Rockingham	"	"	44	6·39	14·37	7½	6	0·86	"	3	11	1,269	Nil	"	"	Nil	64	30	Wood	59	Dirty boards in use and near ware cleaning bench in same room (*cf.* 72). Glaze contains three times as much lead as ordinary earthenware glaze. Ware not shaken after dipping and placed while still damp.
60	Earthenware	"	"	120	†2·00	†1·66	7½	16	†0·27	"	7	3	2,448	"	"	"	"	70	41	Brick	60	Ware placed direct on mangle and no boards used. Low solubility glaze only used.
61	China	"	"	117	Trace	—	8	17	Trace	"	4	—	769	"	"	"	*100	65	51	"	61	Practically leadless glaze used. Ware cleaning in same room.
62	Earthenware	Gathering at mangle	Gatherer	91	16·19	17·73	9	15	2·62	1,660	—	1	541	"	"	"	1,660	70	50	"	62	Only air inlet was doorway from dipping house close to which a dipper was working and dirty boards being placed in a pile. Strong current of air carried dust from dipper and boards over gatherer.
63	"	"	"	194	6·30	3·26	7½	26	0·85	Nil	2	1	336	36·0	36·0	"	Nil	69	46	Cement	63	Moderate current of air into mangle front. Fairly clean boards in use.
64	"	"	"	85	†1·88	†2·22	7½	12	†0·25	"	7	3	2,448	Nil	Nil	"	"	72	40	Brick	64	Low solubility glaze only used.
65	"	Ware cleaning	Cleaner	150	4·58	3·05	7½	20	0·62	720	2	—	501	"	"	"	360	61	28	Cement	65	White ware (somewhat damp) being cleaned at front of mangle. Exhaust good.
66	"	"	"	159	4·54	2·86	7½	22	0·61	720	2	—	501	"	"	"	360	69	—	"	66	Repeat of 65. Same remarks apply.
67	"	"	"	86	9·64	11·25	7½	12	1·30	246	—	2	1,948	"	"	"	123	64	43	Brick	67	Printed ware being cleaned in dippers drying room (*cf.* 79). Exhaust badly applied, boards having to be placed end on to hood.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
68	Earthenware	Ware cleaning	Cleaner	118	9·41	8·00	7½	16	1·27	246	—	2	1,948	Nil	Nil	Nil	123	—	—	Brick	68	Repeat of 67. Same remarks apply.
69	,,	,,	,,	174	8·26	4·75	7½	24	1·12	—	1	2	Large	Large	Large	Large	100	68	49	Cement	69	Printed ware being cleaned at front of mangle. Exhaust moderate. Stillage in same room (*cf.* 78).
70	,,	,,	,,	47	4·11	8·75	7½	6	0·55	174	1	3	1,531	23·3	Nil	Nil	44	63	—	Brick	70	White ware being cleaned. Exhaust badly applied, boards having to be placed end on to hood. Dipping and stillage in same room (*cf.* 65 and 66).
71	,,		,,	89	5·00	5·62	7½	12	0·68	Nil	1	2	7,960	Nil	,,	,,	Nil	56	31	Wood	71	Cleaning bench at side of large stillage. Ware damp and cleaned on wet flannel, no exhaust provided. Dipping in same room.
72	Rockingham	,,	,,	83	11·66	14·00	7½	11	1·57	,,	3	11	1,269	,,	,,	,,	,,	60	30	,,	72	Cleaning bench at side of large stillage. Ware damp and cleaned on wet flannel, no exhaust provided. Dipping in same room. Glaze contains nearly three times as much lead as that of ordinary earthenware.
73	Earthenware	,,	,,	162	†4·05	†2·50	7½	22	†0·55	,,	4	2	4,081	,,	,,	,,	,,	56	37	Brick	73	Low solubility glazed only used. No exhaust in use. Dipping in same room.
74	China	,,	,,	163	8·42	5·16	6	18	0·91	425	5	—	588	1·0	,,	,,	85	54	34	,,	74	Ware very dry. Cleaned by rubbing on dry flannel or brush. Very dusty. Excellent exhaust. Dipping in same room (*cf.* 57 and 58).
75	,,	,,	,,	348	37·77	10·85	6	38	4·08	44	1	1	1,413	Nil	,,	,,	22	54	38	,,	75	Very bad exhaust. Hood so arranged that cleaning must be done outside. Ware very dry and dusty. Dipping in same room (*cf.* 55 and 56).
76	,,	,,	,,	163	Trace	—	8	23	Trace	400	4	—	769	,,	,,	,,	*100	65	55	,,	76	Glaze used practically leadless.
77	Earthenware	Drying and stillaging dipped ware	Those entering stillage, etc.	74	9·63	13·00	9	12	1·56	Nil	2	6	2,988	4·0	,,	,,	336	53	45	,,	77	Stillage in room also used for dipping and ware cleaning. Much traffic. High result probably due to dust from very dirty boards piled near.
78	,,	,,	,,	79	5·47	6·90	7½	11	0·74	,,	1	2	Large	Large	Large	Large	100	67	49	Cement	78	Stillage in room also used for dipping and ware cleaning. Current of air from stillage to ware cleaning at mangle (*cf.* 69). No dirty boards used.
79	,,	,,	,,	60	3·50	5·83	7½	8	0·47	,,	—	2	1,948	Nil	Nil	Nil	123	72	48	Brick	79	Dippers' drying room used also for ware cleaning. Current of air from stillage to cleaning exhaust hood at which 67 and 68 were made.
80	China	,,	,,	82	3·06	3·75	—	—	—	—	—	—	—	3·0	,,	1·0	Nil.	90	39	,,	80	Dippers' drying room in which no work was done except bringing and removing boards of ware.
81	Earthenware	Glost placing	Glost placers	122	5·76	4·73	8¼	18	0·86	Nil	16	—	Very large	Large	Large	Large	,,	55	46	,,	81	Boards not much used. Ovens caused strong current of air through sagger house.
82	,,	,,	,,	107	6·67	6·25	9	17	1·08	,,	15	—	1,200	29·0	29·0	4·0	,,	59	53	,,	82	Very dirty boards in use. Ovens caused very strong current of air through sagger house.
83	,,	,,	,,	60	5·26	8·75	9	10	0·85	,,	8	—	Large	Nil	Nil	Nil	,,	—	—	,,	83	Boards fairly dirty. Ovens caused strong current of air through sagger house.
84	China	,,	,,	85	3·08	3·64	9	14	0·50	,,	5	—	,,	Large	Large	,,	,,	41	38	,,	84	Boards fairly dirty. Ovens caused strong current of air through sagger house.
85	,,	,,	,,	61	0·92	1·50	9½	11	0·16	,,	1	—	,,	,,	,,	,,	* ,,	47	38	,,	85	One man only working. No assistant; placing therefore very slow.
86	,,	Drawing glost oven	Oven drawers	168	Nil	—	4	—	—	—	2	—	—	—	—	—	—	95	33	—	86	Air caused to pass through sodium sulphide solution as well as through filter; no discolouration.
87	Tiles	Tile dipping and cleaning	Dipper and cleaner	35	5·75	16·25	7½	5	0·78	Nil	10	—	1,102	Nil	Nil	Nil	*Nil	51	—	Tiles	87	Tiles damp and cleaned with knife.
88	,,	,,	,,	83	11·66	14·00	7½	11	1·57	,,	2	6	916	,,	,,	,,	Nil.	56	39	Wood	88	Tiles damp and cleaned with knife, but conditions in room (*e.g.* floors, &c.) much less favourable than in 87.
89	,,	Majolica painting	Paintresses	172	25·80	15·00	7½	23	3·48	,,	—	48	437	6·0	,,	,,	,,	59	38	,,	89	Tiles cleaned while still damp with a knife. Much glaze on wooden floor. Much traffic.

* An open fire was burning in these rooms.

† In the factory in which these determinations were made, a glaze was used which yielded only about 1 per cent. of lead to acids, though there was much more in the glaze. The lead was determined in these cases in the same way as in all the other determinations (in order to obtain comparable results), *i.e.*, by extracting the dust with dilute HNO_3. Hence the figures given in columns 6, 7, and 10 do not show the total lead but only that soluble in dilute HNO_3. It seemed necessary to make the estimations of lead in this way, rather than by a method which would have shown the whole of the lead present, in view of the widely accepted view that there is much less danger attending the use of low solubility glaze by reason of the insolubility of the lead contained in it.

TABLE C.

Showing average results of the investigation for different processes.

Nos. of Determinations.	Workers affected.	Dust per 1,000 cubic feet of air.	
		Total dust (mgms).	Lead (Pb) (mgms).
(1)	(2)	(3)	(4)
1 to 4	Tile press workers. Exhaust not applied to either press working or fettling	1,207	—
5 to 8	,, ,, ,, applied to press working but not to fettling -	568	—
9 and 10	Tile fettlers. Exhaust not applied to either press working or fettling - -	2,892	—
11 and 12	,, ,, applied to press working but not to fettling - -	546	—
13	,, ,, ,, both press working and fettling - -	250 (*a*)	—
14 to 16	Passing workers in tile press rooms (centre of room). Exhaust not applied to either press working or fettling.	1,045 (*b*)	—
17	Passing workers in tile press rooms (centre of room). Exhaust applied to press working but not to fettling.	173	—
18 to 22	Potters and assistants working in badly ventilated potters' shops - - -	245	—
23 to 26	,, ,, ,, well ventilated potters' shops - - -	85	—
27 to 29	Towers of earthenware provided with exhaust - - - - - - -	310	—
30	Fettler of flat earthenware working in potters' shop. No exhaust - -	256	—
31 to 33	Bedders and placers of china biscuit ware - - - - - - - - -	473	—
34	China biscuit oven drawers - - - - - - - - - - - - -	598	—
35	Workers emptying china biscuit from saggers at mouth of oven in a strong current of air.	1,676	—
36	Workers emptying china biscuit from saggers in sagger house - - -	2,385	—
37	Persons emptying flint from saggers before sifting - - - - -	2,737	—
38 and 39	Sifters of flint using a closed machine provided with exhaust - - -	166	—
40	,, ,, ,, an open machine provided with exhaust - - -	2,650 (*c*)	—
41 and 42	Persons knocking china flat ware using a closed machine provided with exhaust.	974	—
43	Persons knocking china flat ware by hand with no exhaust applied - -	16,600	—
44 and 45	China scourers using a closed machine provided with exhaust - - -	288 (*d*)	—
46 and 47	,, ,, and fine brushers in hand process with exhaust applied - -	486 (*e*)	—
48	Brushers of flat biscuit earthenware - - - - - - - - -	1,660	—
49 to 52	Dippers and assistants working at mangle front and using no boards - -	109 (*f*)	5·12
54 to 59	,, ,, using dipping boards - - - - - - - -	114 (*f*)	7·91
62 and 63	Gatherers at mangle - - - - - - - - - - - - -	148 (*g*) (*f*)	11·25
65, 66 and 69	Cleaners of earthenware working at front of mangle with exhaust applied and using no dipping boards.	161 (*f*)	5·79
67, 68 and 70	Earthenware cleaners working before exhaust hoods and using dippers' boards.	84	7·72
74 and 75	Chinaware cleaners working before exhaust and using dippers' boards - -	256 (*h*)	23·09
71	Earthenware cleaners doing wet cleaning with no exhaust applied - -	89	5·00
72	Rockingham ware cleaners doing wet cleaning with no exhaust applied -	83 (*m*)	11·66
77 to 79	Persons working in earthenware stillage rooms - - - - - - -	71	6·20
80	China dippers drying room (no persons working continuously) - - -	82	3·06
81 to 85	Glost placers - - - - - - - - - - - - - - - -	87	4·34
86	,, oven drawers - - - - - - - - - - - - - - -	168	nil.
87 and 88	Tile dippers and cleaners - - - - - - - - - - - -	59	8·71
89	Majolica paintresses (of tiles) - - - - - - - - - - - -	172	25·80

NOTES TO TABLE C. (Distinguishing letter in column 3.)

(*a*) Exhaust was applied to the particular fettling bench at which the determination was made, but not to eleven others in same room.

(*b*) In one determination placers were removing saggers and constantly passing filter, thus making air more dusty.

(*c*) In this case there were several points at which dust was produced but which were not affected by the exhaust owing to the machine being constantly open.

(*d*) Rumblers in use. All dust was produced in handling ware.

(*e*) Exhaust drew dust produced in handling ware across scourers, &c.

(*f*) In most of these cases there was a current of air passing from dusty rooms (*e.g.*, an earthenware brushing room) towards the mangles. The total dust figure is therefore higher than in most of the determinations in dipping rooms where there was no mangle.

(*g*) One of the determinations on which the averages are based was exceptionally high due to very faulty exhaust arrangements.

(*h*) One determination on which average is based was exceptionally high due to faulty exhaust provided.

(*m*) Rockingham glaze contains from $2\frac{1}{2}$ to 3 times as much lead as ordinary earthenware glaze.

TABLE D.

Showing details of temperature and aspiration in rooms where no lead is used and in which determinations of dust were made.

No. of determination.	Workers affected.	Temperature. In room. Wet bulb Fah. °	Temperature. In room. Dry bulb. Fah °	Temperature. In outside air. Wet bulb. Fah. °	Temperature. In outside air. Dry bulb. Fah. °	Aspiration. Duration. Hrs.	Aspiration. Duration. Mins	Aspiration. Volume of air aspirated. c. ft.	Aspiration. Total dust collected. mgms.	No. of determination
(1)	(2)	(3)	(4)	(5)	(6)	(7)		(8)	(9)	(10)
1	Tile pressers	—	52	41	50	3	35	9·05	12·5	1
2	„ „	47	50	39	44	1	45	7·79	9·0	2
3	„ „	44	48	34	37	2	0	7·07	12·1	3
4	„ „	52	58	46	49	2	20	10·00	15·8	4
5	„ „	56	60	48	50	1	50	8·00	6·0	5
6	„ „	54	61	43	44	1	40	7·00	3·8	6
7	„ „	—	64	—	—	1	20	6·00	3·1	7
8	„ „	54	59	49	55	2	15	12·00	5·5	8
9	Tile fettlers	56	60	48	50	1	25	4·00	18·2	9
10	„ „	50	52	45	48	1	45	6·00	7·4	10
11	„ „	56	61	49	54	2	40	13·00	6·4	11
12	„ „	54	60	43	44	1	20	5·00	3·0	12
13	„ „	54	61	43	44	2	15	8·00	2·0	13
14	Tile pressers and fettlers	47	52	41	44	2	30	5·40	4·4	14
15	„ „	47	51	36	—	1	45	11·26	11·0	15
16	„ „	51	53	46	48	1	40	7·00	9·4	16
17	„ „	48	51	42	45	2	0	11·60	2·0	17
18	Potters and assistants	65	75	45	47	3	5	11·20	2·5	18
19	„ „	65	67	36	38	3	25	13·00	3·2	19
20	„ „	60	68	49	53	2	25	11·00	2·1	20
21	„ „	67	74	46	50	2	30	10·00	4·5	21
22	„ „	55	59	43	46	2	43	13·00	1·5	22
23	„ „	67	72	42	44	2	15	11·40	0·7	23
24	„ „	63	71	42	44	2	27	12·00	1·2	24
25	„ „	69	77	43	44	3	35	14·00	1·5	25
26	„ „	58	64	44	46	2	50	14·40	1·0	26
27	Towers	59	66	42	44	1	35	6·00	1·8	27
28	„	51	57	42	44	1	50	7·00	2·1	28
29	„	58	67	42	44	2	55	10·00	3·3	29
30	Earthenware fettlers	54	59	37	40	3	15	11·70	3·0	30
31	Biscuit placers	49	50	47	49	2	15	10·30	5·0	31
32	„ „	50	52	49	52	1	35	8·00	2·9	32
33	„ „	51	57	45	47	1	25	6·30	3·6	33
34	Oven drawers	64 to 87	82 to 154	43	47	2	0	8·70	5·2	34
35	Biscuit emptiers	—	47	43	47	1	25	6·50	10·9	35
36	„ „	56	62	48	51	1	35	5·20	12·4	36
37	Sagger emptiers	—	—	—	—		40	3·18	8·7	37
38	Flint sifters	43	46	43	46	2	00	10·70	2·2	38
39	„ „	43	46	43	46	2	10	8·00	1·0	39
40	„ „	56	64	48	52	1	20	5·32	14·1	40
41	Flat knockers	48	52	48	52	1	15	5·00	4·9	41
42	„ „	49	51	48	51	2	28	12·40	12·0	42
43	„ „	56	62	48	51		20	1·00	16·6	43
44	China scourers	52	58	41	44	2	20	10·00	3·0	44
45	„ „	54	57	49	52	1	40	8·00	2·2	45
46	„ „	48	50	43	43	2	10	11·80	4·7	46
47	Fine brushers	44	48	36	37	2	10	11·00	6·3	47
4	Earthenware brushers	56	65	41	46	1	5	5·00	8·3	48

TABLE E.

Showing details of temperature and aspiration in rooms where lead is used and in which determinations of dust were made.

No. of Determination.	Workers affected.	Temperature. In room. Wet bulb.		Temperature. In outside air. Wet bulb.		Aspiration. Duration.		Aspiration. Volume of air aspirated.	Aspiration. Dust collected. Total.	Aspiration. Dust collected. Lead (Pb).	No. of Determination.
		Wet bulb. Fah. °	Dry bulb. Fah. °	Wet bulb. Fah. °	Dry bulb. Fah. °	Hrs.	Min.	c. ft.	mgms.	mgms.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)		(8)	(9)	(10)	(11)
49	Dippers and assistants -	71	91	—	43	5	00	18·0	4·6	0·110	49
50	,, ,, -	59	67	47	49	2	15	9·0	0·9	0·030	50
51	,, ,, -	72	100	—	—	2	25	10·0	0·4	0·050	51
52	,, ,, -	72	100	—	—	0	43	5·0	0·2	0·030	52
53	,, ,, -	72	100	—	—	2	10	10·3	0·4	0·020	53
54	,, ,, -	46	51	35	36	2	45	13·0	3·1	0·230	54
55	,, ,, -	55	58	50	52	2	45	15·0	0·8	0·025	55
56	,, ,, -	52	54	48	50	2	22	12·0	1·4	0·040	56
57	,, ,, -	44	47	35	36	1	45	8·5	1·0	0·095	57
58	,, ,, -	52	55	40	41	1	30	7·0	0·8	0·050	58
59	,, ,, -	59	64	31	30	4	50	18·0	0·8	0·115	59
60	,, ,, -	60	70	39	41	2	45	10·0	1·2	0·020	60
61	,, ,, -	58	65	51	51	2	5	12·0	1·4	Trace	61
62	Gatherers at mangle -	61	70	48	50	5	0	23·0	2·1	0·373	62
63	,, ,, -	61	69	44	46	4	47	23·8	4·6	0·150	63
64	,, ,, -	57	72	35	40	2	10	10·6	0·9	0·020	64
65	Ware cleaners - - -	53	61	—	28	3	55	12·0	1·8	0·055	65
66	,, ,, - - -	59	69	—	—	3	15	13·2	2·1	0·060	66
67	,, ,, - - -	55	64	40	43	3	55	14·0	1·2	0·135	67
68	,, ,, - - -	—	—	—	—	1	30	4·3	0·5	0·040	68
69	,, ,, - - -	60	68	46	49	2	35	11·5	2·0	0·095	69
70	,, ,, - - -	—	63	—	—	3	5	8·5	0·4	0·035	70
71	,, ,, - - -	51	56	31	31	2	40	9·0	0·8	0·045	71
72	,, ,, - - -	55	60	30	30	3	40	12·0	1·0	0·140	72
73	,, ,, - - -	51	56	35	37	1	40	7·4	1·2	0·030	73
74	,, ,, - - -	48	54	32	34	3	57	19·0	3·1	0·160	74
75	,, ,, - - -	51	54	37	38	4	0	13·5	4·7	0·510	75
76	,, ,, - - -	57	65	50	55	1	35	8·6	1·4	Trace	76
77	Those entering stillage or drying room.	49	53	41	45	5	55	27·0	2·0	0·260	77
78	,, ,,	59	67	47	49	5	30	26·5	2·1	0·145	78
79	,, ,,	61	72	45	48	5	0	20·0	1·2	0·070	79
80	,, ,,	76	90	39	39	3	0	14·7	1·2	0·045	80
81	Glost placers - - -	51	55	45	46	4	50	23·0	2·8	0·133	81
82	,, ,, - - -	55	59	49	53	6	45	30·0	3·2	0·200	82
83	,, ,, - - -	—	—	—	—	2	55	13·3	0·8	0·070	83
84	,, ,, - - -	40	41	38	38	2	15	13.0	1·1	0·040	84
85	,, ,, - - -	44	47	37	38	4	15	16·3	1·0	0·015	85
86	Oven drawers - - -	70	95	—	33	5	15	14·3	2·4	Nil	86
87	Tile dippers and cleaners	47	51	—	—	3	15	11·3	0·4	0·065	87
88	,, ,,	49	56	36	39	2	15	12·0	1·0	0·140	88
89	Majolica paintresses -	51	59	35	38	1	55	9·3	1·6	0·240	89

TABLE F.

Showing results of a number of dust determinations made in rooms not generally regarded as dusty, and one also in the open air.

Determination.	Position of filter at the breathing level.	Total dust found per 1,000 cubic feet of air.	Aspiration. Time.		Aspiration. Volume of air aspirated.	Dust collected.
		mgms.	Hrs.	Mins.	cubic feet.	mgms.
A	Side of laboratory at Christ Church, Oxford.	36·0	8	0	36·0	1·3
B	Side of laboratory at Stoke - -	31·0	8	10	35·3	1·1
C	Centre of laboratory at Stoke -	52·8	7	15	36·0	1·9
D	Outside air, Stoke - - -	21·8	10	45	55·0	1·2
E	Side of Study, Edgbaston - -	26·6	12	30	60·0	1·6

In determination A the day was foggy at first and fine later, and all surfaces outside were damp. A chimney was being repaired during part of the time, about 20 feet away from the filter. The floor was of stone. In determination B three people were in the laboratory, and for 20 minutes the

wooden floor was being swept. No work was proceeding, the day was dull and rainy at times, and all surfaces outside were damp. In determination C six people were working in the room, including two electricians experimenting with an electric furnace. Several more people were in the room for a short time. The floor was of wood and outside all surfaces were damp. Determination D was made in the laboratory yard and no work was proceeding near. The position chosen was some distance from the road and was near the railway station. The wind was blowing from the station about half the time, and towards it for the remainder. All surfaces were wet after heavy rain. Determination E was made in my study in Birmingham. Three people and a dog were occupying the room at intervals during the day, which was beautifully fine, with rather a high wind. Outside, the surfaces were dry. There was very much less sooty matter in the dust than was found in that collected in determinations in Stoke. The floor was covered with a carpet, there was a fire burning, the window was open a little, and gas was burning for three hours of the time occupied by the experiment.

TABLE G.

Showing particulars of samples of dust collected from various points in rooms in which determinations of lead in the air were made.

No. of Sample.	Process carried on in room from which Sample was collected.	Point of collection.	Percentage of Lead (Pb) in dust.	Dust filtered from air in same room.	
				Percentage of Lead (Pb) in dust.	No. of Determination in Table B.
(1)	(2)	(3)	(4)	(5)	(6)
1	Dipping	Side, 12 ft. from floor	11·28	2·39	49
2	,,	Hole in wall, 8 ft. above floor	1·87	{ 9·50 6·25	58 59
3	Dipping and ware cleaning	Centre, 10 ft. above floor	Trace	Trace	{ 57 74
4	,, ,, ,,	Window ledge at side	5·04	13·00	77
5	,, ,, ,,	Centre, 10 ft. from floor	5·73	6·90	78
6	,, ,, ,,	Hole in wall, $4\frac{1}{2}$ ft. from floor	5·57	8·75	68
7	Dipping and cleaning tiles	9 ft. from floor. Tops of lamp reflectors.	2·91	16·25	87
8	,, ,, ,,	Centre, 8 ft. from floor	7·08	14·00	88
9	Ware cleaning	Side, 9 ft. from floor	2·86	3·05	66
10	,, ,,	Side, $7\frac{1}{2}$ ft. from floor	2·59	{ 11·25 5·83	69 79
11	Gathering at mangle	Above mangle head, 8 ft. from floor.	10·41	17·73	62
12	,, ,,	Centre, 7 ft. from floor	6·87	3·26	63
13	Majolica painting	Floor in gangway	12·15	15·00	89
14	,, ,,	Side, 8 ft. from floor	11·60	15·00	89
15	,, ,,	Centre, 10 ft. from floor	2·46	—	None
16	Dippers drying room	Centre, $8\frac{1}{2}$ ft. from floor	1·31	3·75	80
17	Glost placing	Side, 8 ft. from floor	0·96	6·25	82

It is plain from these results that lead is generally distributed throughout the atmosphere of workshops in which it is used.

Tile Making.

The processes in tile making from dust of a mixed clay body are (a) pressing, and (b) fettling, the fettler acting as assistant to the presser. The principal sources of dust are (a) from the press die and (b) from fettling. In the former case dust is carried into the atmosphere by the rapidly escaping air which is forced out of the clay dust in the die by the descent of the plunger. In the latter the edges of the pressed tile are rubbed with sand-paper, the rapid flicking of which causes the dust rubbed off to mix thoroughly with the air.

Seventeen dust determinations were made in tile-pressing workshops. Of these, eight were near the breathing point of pressworkers, five near that of fettlers, and four were at the general breathing level near the centre of the room. In some cases local exhaust was applied, and though in no case was this entirely satisfactory, there can be no question as to the desirability of its provision. Thus, in the case of press-workers four determinations (Nos. 5, 6, 7, and 8) were made where exhaust was provided, and four (Nos. 1, 2, 3, and 4), where there was no local exhaust. The average amount of dust found per 1,000 cubic feet of air in the four determinations where exhaust was applied was 568 milligrams, while in the other four where there was no exhaust it was 1,207 milligrams.

Even where exhaust was applied to the die, there was no provision of a separate exhaust for the process of fettling, which is even more dusty than press-working, though it does not appear to the eye to be so (*cf.* determinations 9 and 10, and 1, 2, 3, and 4.) In those cases where local exhaust is applied to press-working there can be no doubt that a large proportion of the dust found in the air near the breathing point of press-workers originates from fettling, and hence if exhaust were applied to the latter process, the dust breathed by the pressers would be largely reduced.

The provision of local exhaust, however applied, undoubtedly lowers the quantity of dust in a given volume of air for all processes in the same room. Thus, in fettling, two determinations (Nos. 9 and 10) were made where no air at all was mechanically extracted, and two others (11 and 12) where local exhaust was in operation at the presses. In the former case the average quantity of dust found per 1,000 cubit feet of air was 2,892 milligrams; in the latter it was only 546 milligrams. Determinations 10 and 11 are directly comparable, as they

were made in the same position, the one without, and the other with exhaust applied to the presses with the same girl doing fettling. In the former case, in which the fan was stopped during the determination, the dust found was 1,233 milligrams, and in the latter 492 milligrams per 1,000 cubit feet of air. Determinations 4 and 5 are also similarly comparable for pressworkers, the fan being stopped during 4 and in operation during 5. In the former case the dust found was 1,580 milligrams and in the latter 750 milligrams per 1,000 cubit feet of air.

The provision of local exhaust at every point of dust production is shown to be desirable, however, by determination 13, which was made at the breathing point of the only fettler noted as being provided with exhaust. This was applied at the instance of Mr. A. Vernon Harcourt (a member of the Committee), as an experiment, and it enables a very valuable comparison to be made. Determinations 12 and 13 were carried out at the breathing points of two fettlers working side by side, exhaust being applied to all the presses in the room (12), but not to any of the 12 fettlers, except in the case of Mr. Harcourt's experiment. The dust found in this determination was only 250 milligrams per 1,000 cubit feet of air, while in No. 12 at the next bench it was 600 milligrams, the conditions in the latter case being exactly the same except that there was no local exhaust to the fettling. There can be no doubt that some of the dust found in determination 13 originated from some of the other fettlers, and hence if local exhaust were applied to fettling as well as to pressing the proportion in the air would be lowered even beyond that found in this determination.

Of the four determinations (14, 15, 16, and 17), in the centre of the room, and therefore distant from any particular source of dust, three (Nos. 14, 15 and 16) were in workshops where no local exhaust was anywhere in operation, and one (No. 17) was in a workshop where air was locally extracted from the presses, but not from the fettlers. In the former case the average quantity of dust per 1,000 cubic feet of the air was 1,045 milligrams, while in the other case where local exhaust was applied it was 173 milligrams. Determination 14 (815 milligrams) was made in the centre of the same room as 1 (1,380 milligrams) and 2 (1,155 milligrams), which were both made at the breathing point of the pressworker, and therefore near the source of dust. No. 15 (977 milligrams) was made in the centre of the same room as 3 (1,711 milligrams), which was made at the press. In both rooms ventilation was poor, and the results show that under such conditions the atmosphere becomes generally impregnated with dust throughout the whole of the room. In neither case was anyone working in the centre, though of course workers were constantly passing. Determination 16 was made in the same room and at the same point as 17, the exhaust applied at the presses being in operation in the latter case (173 milligrams dust) but not in the former (1,343 milligrams dust). The exhaust was badly applied, but the results show how effective exhaust can be in maintaining the purity of the air when locally applied at the point at which dust is produced.

The subsidiary sources of dust in tile-pressing shops are (1) the placing of dust in the press trays; (2) the dusty hands of the workers as they grasp the handle of the press wheel to swing it; (3) the brushing of clothing against floors, benches, etc.; (4) the vibration of floors, benches, etc. In (1) there is a small evolution of dust as it is poured from the receptacle in which it is carried from the dust ark into the tray. This is not great if moderately carefully done, and provided local exhaust were applied to the presses and fettlers the dust would never come near the workers' faces. In some cases it was noted that dust was brought to the workshop in sacks. These are exceedingly dusty. In most cases, however, zinc boxes or trays were in use, and there appears to be slight objection to this method. More dust is produced by (2), but again, provided exhaust were applied to the presses, etc., I do not think much danger can be apprehended from this source. There is much more force in (3) in the case of women than men, as the form of dress worn by women causes a considerable disturbance of air. The dust also collects in the material, and at every shake escapes in a cloud. This is no doubt chiefly due to settlement of dust from the air, and would therefore be prevented by provision of efficient exhaust at the main points of production, *i.e.*, pressing and fettling. It was noted that (4) had very much more force in the case of wooden than in that of brick floors. Every sharp vibration of the former resulted in the production of a cloud of dust, but no such effect was observed in the case of rigid floors.

Determination 17, made in the centre of a workshop, has a direct bearing on most of the subsidiary sources of dust in rooms where exhaust is provided. The room was narrow, with benches round the walls, and had a brick floor. No work was done in the centre, but the workers were constantly passing. The quantity of dust found (173 milligrams per 1,000 cubic feet of air) is much the same as is found in the air of potters' shops, though no separate exhaust was provided for the process of fettling. That applied to the presses, however, tended to prevent the dust produced in fettling reaching the centre of the room. The result shows that if efficient exhaust were applied to the two chief sources of dust there is comparatively little danger to be apprehended from the minor sources.

Generally it would appear advisable in tile press workshops that:—

(1) The dust produced in pressing and fettling should be removed by efficient exhaust applied separately to each process.

(2) The bringing of clay dust into workshops in sacks should be prohibited.

(3) Wooden floors should be prohibited.

Potters' Shops.

The processes usually carried on in potters' shops are: (1) the working of clay, *i.e.*, pressing, jolleying, throwing, turning, etc.; (2) the drying of the article into which the wet clay has been shaped; (3) towing; (4) fettling. Drying necessitates the provision of some method of heating, which generally takes the form of stoves heated at the bottom by steam pipes, while towing and fettling are productive of dust. The chief source of dust, however, in the atmosphere of potters' shops is the collection of pieces of dried clay on the floor, which, after being pulverised by movements of the occupants, rises in the form of fine clay dust. A minor source is the manipulation of the dried moulds of plaster of Paris.

Nine tests were carried out in potters' shops, the average amount of dust found per 1,000 cubic feet of air being 174 milligrams. The proportion of dust found in the air varied very strikingly with the manner in which ventilation was applied. The nature of the work tends to the provision of long narrow shops, with working benches arranged along the outside walls and stoves for drying the ware placed behind the workers. Determination 18 was made in a workshop with one open door at the end of one side of the room and practically no other ventilation. Being a long narrow shop this door could only provide ventilation for a small area in its immediate neighbourhood. The dust found was 223 milligrams per 1,000 cubic feet of air. No. 19 (246 milligrams) was made in a room with practically no ventilation at all, though it was a fine big modern workshop. The room in which 21 (450 milligrams) was made was also a long shop ventilated only by means of a door opened occasionally at one end and a few small openings at the ceiling level on one side, and in the cases of 20 (191 milligrams) and 22 (115 milligrams per 1,000 cubic feet of air) the rooms had practically no ventilation. The traffic, however, was small. Those rooms in which determinations 23, 24, and 25 were made were exceedingly well ventilated, in the case of 23 (62 milligrams per 1,000 cubic feet of air) by open skylights all down the length of a very long and narrow shop and open doors at each end, and in the case of 24 (100 milligrams) and 25 (107 milligrams) by open skylights or louvres along the whole length of the roof, and by exhaust to the towing benches at intervals down the length of the shop. The average amount of dust found per 1,000 cubic feet of air in determinations 18, 19, 20, 21, and 22, in rooms either not ventilated at all or with all the air inlets at one point, in a position

unsuitable for ensuring change of air, was about 245 milligrams, while in the case of those rooms where the air inlets were distributed and change of air was made possible all through the shops, the average was only 90 milligrams (determinations 23, 24, and 25). The amount of traffic in the rooms where determinatons 23, 24, and 25 were made was enormous, much more indeed than in any other rooms investigated, while the cubic space per person was much smaller, being in one case less than that required by the Factory Act. Indeed, a cursory examination of these shops, but not of the ventilation, induced me to make tests in the belief that it would give an idea of what might be expected under bad conditions. Determination 26 (69 milligrams) was made in a workshop in which there was very little movement, and in which also a large open fire was burning.

Examination of the air currents showed that in nearly all cases where a supply of air was obtainable a current of cold air passed into the stoves over the lower part of the openings, while in all cases a current of hot air issued from the stoves over the upper part of any opening, the velocity of the hot current being greater, of course, than that of the cold. At ventilation openings in the workshop the current was usually pulsating, *i.e.*, first inwards and then outwards. The hot current issuing from the stoves of course raised the temperature of the room greatly.

In this connection it should be noted that the temperature of the room varied with the means of ingress to the stoves. Usually the moulds to be dried are placed on "dobbins" which are verticle pivoted doors with shelves arranged horizontally one above the other. Sometimes these take the form of a simple door pivoted in the middle with shelves on each side, one side of course facing into the stove, and one side into the room. In this case the moulds are placed on the shelves facing the room till they are full, when the dobbin is turned round with the filled side facing into the stove, the ware being thus dried while the other side is being filled. The result of this arrangement is that the opening into the stove is always closed except for a few seconds when the dobbin is being turned.

The average temperature at the breathing level near the point where the people work in three shops (determinations 20, 22, and 30), where such dobbins were in use was 56° F. on the wet bulb and 62° F. on the dry bulb.

In other cases the dobbin takes the form of a cross with shelves one above the other on each arm, and the pivot in the centre of the cross about 2 feet inside the stove. In filling this, the mould-runner (the young person who carries the moulds from the potter to the stove) arranges the dobbin so that two of its adjacent arms form a V facing the opening, and he actually enters the stove to place the moulds on the shelves. As soon as one V of the cross is filled it is turned and the next V emptied and refilled. There is thus always a part of the stove open to the room, through which hot air pours. The average temperature in five cases (determinations 23, 24, 25, 21, and 18) noted with such dobbins in use was 66° F. on the wet bulb and 74° F. on the dry bulb. Hence the high temperature usually associated with potters' shops appears to be principally due to the passage of a current of hot air from the stove openings into the shop and not to radiation. It has been shown above that good ventilation of the shops ensures considerable lowering of the dust content of the air, while there is no doubt that the stoves do ventilate themselves by pouring hot air into and extracting cold air from the shops. Therefore, what appears to be necessary is to ensure that the hot air instead of passing into the room shall pass into the open air by properly constructed ducts over each entrance to the stove, while the supply of air to the room is made certain by properly constructed air inlets arranged throughout the whole area of the room. In other words the stove should be made to exert its own uncontrolled energy (which at present is certainly lost to the manufacturer and heats the air of the room to an uncomfortable degree) in ventilating the room, and so at once reducing the quantity of dust in the air and also the temperature. In only two cases were there wooden floors in potters' shops where dust determinations were made. In one of these (No. 25) the number of persons engaged was small and the traffic slight, in the other (No. 24), however, the workers were many and the traffic great. The result is shown by the high proportion of dust in the air, *i.e.*, 450 milligrams per 1,000 cubic feet of air, this being the only case where the dust in potters' shops exceeded 250 milligrams per 1,000 cubic feet of air. Another point noted was that when removing such articles as plates, saucers, etc., from moulds, the surplus clay round the edges, which separates from the plate in drying, was generally allowed to fall on the floor. Occasionally a box having a tray in the form of a grid on its upper open side was provided, and the plate was removed from the mould over this, the dried clay being allowed to fall through the grid into the box.

It appears desirable that in all potters' shops:—

(1) Efficient air inlets should be provided and so arranged that through ventilation without draughts is caused throughout the whole of the workshop.

(2) There should be properly constructed ducts leading to the open air over each opening into the stove; or the stove should be so ventilated that an outward current of air from the stove into the room is prevented.

(3) Boxes should be provided for the reception of pieces of dried clay, and it should be compulsory for potters' assistants and others to remove dried ware from moulds over this box, so as to ensure surplus clay or broken pieces of ware falling into it.

(4) Wooden floors should be prohibited.

Flat Fettling and Towing of Earthenware.

In towing the worker places a plate in the clay state, after drying, on a block, known as a whirler, which is revolved by machinery. She then holds a tool made of hoop-iron, sharpened and notched, against the edge of the plate in order to smooth it. Finally, she holds a handful of tow against the edge and on the surface of the revolving plate. Both processes are dusty, but the latter is especially so.

Three determinations (Nos. 27, 28, and 29) were made in connection with towing, and of these two (27 and 28) were in rooms entirely set apart for towing, while one was in a workshop also used as a potters' shop. The average quantity of dust found per 1,000 cubic feet of air was 310 milligrams. In all cases excellent local exhaust was provided, and the results were remarkably similar. In the case of determination 27, a very large stillage filled up the greater part of a very large shop, the towing being done on one side. There was a large traffic in this stillage, due to potters' assistants bringing ware from the potters' stoves, and to towers fetching ware for towing. The floor was thickly coated with dust, due to breakage of the fragile dried clay ware, which, falling on the floor, was quickly trodden into dust. The condition of the floor was much worse than in any potters' shop I have ever seen. The air inlets were in part on the side of the room opposite from the towing exhaust, and hence the dusty air from the stillage was drawn right across the towers, and this, I think, provided the greater part of the dust found.

In the case of determination 28, the fans, of which there were four, discharged into the open air along the side wall of the towing shop. All the air inlets to the shop were on this side, and though, no doubt, the greater part of the dust was dissipated in the open air, some could be distinctly seen passing through the air inlets into the room again. The odour of smoke produced in the vicinity of the fan discharge was also quickly perceived in the room, showing that the exceedingly powerful air current which was correctly removing the dust generated in towing, was creating at the same time a reduction of pressure in the workshop, sufficient to cause a current of dusty air to pass back into the room from outside through doors and windows.

Determination 29 was made in a potters' shop with a wooden floor, in which there was considerable traffic and also a stillage at the back of the towing bench. These factors, again, were apparently the cause of the high result, as the dust from the towing was visibly removed by the exhaust provided.

Two determinations (Nos. 24 and 25) were made in a potters' shop, in which also towing was done, where air inlets were provided throughout the whole area of the room by skylights or louvres in the very narrow and low roof. The average quantity of dust found was only 104 milligrams per 1,000 cubic feet of air.

It appears desirable that in towing workshops:—

(1) The stillage should, where possible, be effectually separated from the part devoted to towing;

(2) Air inlets should be provided throughout the area devoted to towing in near proximity to the towing hoods, so as to avoid drawing dust, generated at a distance, over the workers;

(3) Means for collecting the dust or for discharging it into the air high above, or at some distance away from the air inlets to rooms, should be provided.

(4) Wooden floors should be prohibited.

Fettling is also a process of trimming off and smoothing the edge and surface of clay ware. A steel tool for scraping the edge is used, but subsequently the smoothing of the edge and of the surface of the ware is done by rubbing with a wet sponge. Moreover, the plate to be fettled is never so highly dried as for towing, and a hand whirler is generally used. Hence but little dust is generated, the part of the process which is most dusty being entirely omitted. Further, the "sponging off," as the second part of the fettling process is called (which, being wet, produces no dust), occupies at least twice the time of the first part, where such dust as is produced is generated. Usually fettling is done in a potters' shop, and one determination (No. 30) was made at the breathing point of a woman doing this operation. The shop was used by three potters and their assistants (of whom three were fettlers) and had a wooden floor. The quantity of dust found per 1,000 cubic feet of air was 256 milligrams, aspiration being continued for $3\frac{1}{4}$ hours, during two hours and five minutes of which the fettler was sponging off. In the adjoining potters' shop where no fettling was being done and where the conditions were almost identical, the dust found was 115 milligrams per 1,000 cubic feet of air (No. 22). In neither case was there much traffic in the shops. Hence it may be taken that fettling causes a considerably more dusty atmosphere than is caused under similar conditions in potters' shops where no fettling is done.

It may appear advisable that exhaust should be applied to fettling, but it is, perhaps, a border line case.

Work in the Sagger House.

Bedding and Placing of China.

In the process of placing china, in the clay state, for firing into biscuit, ground flint is used for placing between and over the pieces of ware in the sagger. The process of placing generally adopted for flat ware—saucers, plates, etc., is called flat bedding and flinting, and that for hollow-ware—cups, etc.—is termed "hollow-ware placing." In both cases dust is produced, which is decidedly irritating. In the former, the flint is placed in a small heap, a depression made in it, and the plate gently pressed down on it, producing a small puff of dust. Also, when the sagger is filled with plates, flint is heaped and dusted over the pile, and again dust is produced. In this process one determination was made (No. 31), the quantity of dust found being 485 milligrams per 1,000 cubic feet of air. The flint was, however, cold and somewhat damp —when used warm and dry much more dust is created, as I subsequently noted.

In hollow-ware placing dust is produced during sifting of flint on to the ware in the sagger. A determination at the breathing point of the placer (No. 32) showed that 363 milligrams of dust were present per 1,000 cubic feet of air. One determination (No. 33) was also made at the breathing point of a placer doing both flat bedding and hollow-ware placing, the result showing the presence of 571 milligrams per 1,000 cubic feet of air. The flint in this case was warmer and drier than in those referred to above.

It would appear desirable that:—

(1) Local exhaust should be applied to all bedding and placing;

(2) Suitable air inlets in close proximity to the bedders and placers should be provided to ensure that a current of air sweeps the dust away from the workers.

China Biscuit Drawing.

The process of biscuit drawing is the removal of saggers of ware from the oven after being fired. Dust is produced chiefly by breaking of saggers when being lifted, and by removal of ware from saggers already too badly broken to be moved with the ware inside. The flint in which the ware is bedded rises in clouds. Minor sources are the friction of one sagger against another and the lifting, which causes flint dust to rise from the open top.

In determination 34 the filter was moved about inside the oven as the point of working altered. The dust found per 1,000 cubic feet of air was 598 milligrams.

The temperature inside the oven showed great variations, as given in the following table:—

Position of Thermometer.	Temperature. Wet Bulb. Fah.	Temperature. Dry Bulb. Fah.
Side of oven over orifices from fire-place into oven - - - -	64°	87°
	—	91°
Half-way between wall and centre of oven.	70°	90°
Over the third ring - - - -	—	94°
Between middle ring and central flue	—	91°
In centre (over central flue) - -	82°	154°

This indicates that the precise point for taking the temperature must be fixed, if any limiting temperature is specified for drawing ovens. The fairest point would appear to be half way between the wall of the oven and the centre, on the axis at right angles to that passing from the oven door to the back.

Biscuit Emptying.

The process of biscuit emptying is the removal of the fired ware from the bed of flint in the saggers, after the latter are drawn from the oven. Much dust is produced by the movement of the very dry flint. Sometimes the saggers are emptied on a temporary stage at the mouth of the oven, and sometimes in the sagger house. Two determinations were made in this process, one where the ware was removed at the mouth of the oven and one where it was removed in the sagger house. In the former case (No. 35) the dust found was 1,677 milligrams per 1,000 cubic feet of air, and in the latter 2,385 milligrams (No. 36), the average being 2,031 milligrams. When saggers are emptied at the mouth of the oven the strong current of air induced by the hot oven tends to lower the proportion of dust in the air, while in the sagger house there is usually not the same movement of air, and the result is shown in the higher value for the dust content of the air in the latter case. The operation is certainly one where exhaust is desirable, but whether it is practicable is perhaps a question. Personally, I think it is, though some alteration of method would be necessary, and it would be necessary to have a special bench provided with exhaust, to which the saggers could be removed and emptied as they come from the oven. It should also be borne in mind that the men do not work in the process continuously. At the same time the operation is one of the most dusty noted, and probably the dust produced is one of the most dangerous. Therefore some method of reducing the dust should be found.

Emptying Flint from Saggers.

This is an intermittent operation carried out after the biscuit ware has been removed. A great deal of flint remains in the saggers, and is emptied into boxes and carried to the flint ark ready for sifting. One determination (No. 37) was made, and the dust

found per 1,000 cubic feet of air was 2,737 milligrams. This was one of the most dusty operations noted, and as the filter had to be moved as the man worked along a stock of saggers I was compelled to remain in the cloud of dust produced. As I made no movements which would shake off the dust, I became white from head to foot. It is, however, only done for about twenty minutes at a time, at intervals, as the flint is required for sifting, and is usually done in the neighbourhood of the oven, where there is a strong current of air. I have at present no suggestion to make as to this process. Further investigation is necessary.

Flint Sifting.

After the flint has been used for china bedding and has been fired, it becomes mixed with foreign matters and is more or less caked. It is therefore sifted to free it from the foreign matters, and to bring it into a fine floury condition. Generally, some form of enclosed machine, worked either by power or hand, is now used, usually in connection with mechanical exhaust.

Three determinations were made in connection with such machines, both worked by power. In the first factory the sifter took the form of a reciprocating sieve working in an enclosed chamber, from which a fan exhausted the air. Below the sieve was an ark or chamber for the reception of the sifted flint, having an opening at the ground level, outside, for its removal by means of a box, into which it could be raked, the extraction of air by the fan being sufficient to ensure an inward current of air whenever this was being done. The man working at the machine stood on a platform, took the boxes of unsifted flint from an assistant, and emptied them into the moving sifter. In doing so his head was put inside the chamber, and he would thus inhale some dust. This was a fault in the construction of the machine. The filter was placed at the breathing level on the platform, immediately over the door through which the flint was put into the machine, and the result showed (No. 38) that at this point there was present per 1,000 cubic feet of air 206 milligrams of dust. In the second determination (No. 39) the filter was placed over the stage on which boxes of unsifted flint were put ready for the worker to place in the machine. Here there was present per 1,000 cubic feet of air 125 milligrams of dust. The average of the two experiments was 165 milligrams per 1,000 cubic feet of air. Some dust escaped when the entrance to the sifter chamber was opened, and some dust was produced by the knocking of the boxes in which the flint was brought to the sifter. Generally speaking, however, the operation was not dusty, and probably the amount of dust inhaled by the worker would be less than the average for potters' shops. The machine is only in an experimental stage and should be provided with a hopper for delivering the flint on to the sieve, or with some means for placing the flint in the sifter without having to open the sifting chamber.

In the other determination (No. 40) the filter was suspended in the centre of the small room devoted to flint-sifting. On one side of the room was the ark for unsifted flint (which, normally is having flint added periodically, but which, during the test, was not replenished), and on the adjacent side of the room was the sifter consisting of two reciprocating sieves working in a chamber with one open side. The worker shovelled flint from the ark into the sieves through the open side. A powerful exhaust current was provided in the top of the sifter chamber. The flint fell from the sieves into trays below, in which it collected in a fine floury and very dusty state. The trays, when full, were drawn out and emptied into the ark for sifted flint in the next room. The quantity of dust found was 2,650 milligrams per 1,000 cubic feet of air, this being one of the most dusty operations investigated. The comparison between the two methods was valuable. In one, the sifter was entirely enclosed, and the sifter chamber was only open for a few seconds at a time when the box of flint was emptied on the sifter. Further, the flint was only handled once between the saggers and the ark for sifted flint, *i.e.*, in being transferred from the saggers to boxes and from the boxes on to the sifter. In the other the sieve chamber was always open, the flint was handled several times in its course to the sifted flint ark, and dust was produced by (1) emptying unsifted flint into its ark, (2) shovelling it from the ark to the sifter, (3) escape from the open front of the machine, (4) escape from the trays into which the flint falls, (5) removal of the sifted flint to the sifted flint ark, and replacement of the trays in the machine. In the first case also the exhaust was far better applied, for though the quantity of air moved was less than in the second, it was so arranged that air was caused to pass inwards through every opening in the machine, the openings being kept small in size and number. In the second case, while the openings were large some of them were so situated that it was impossible for the fan to cause an inward current through them. Many more flint-sifting workshops were examined, but in all the dust was visibly greater than in that in which determinations 38 and 39 were made.

It would therefore appear desirable that:—

(1) All flint sifting should be done in a machine entirely closed during sifting.

(2) This machine should be provided with exhaust, so arranged as to produce an inward current through every opening in the machine for introduction or removal of material.

(3) The fired flint should be handled as little as possible between its removal from the saggers and its reception in the sifted flint ark.

Flat Knocking.

On removing china flat ware in biscuit from the saggers after firing it is found that the ware and the flint in which it is bedded have aggregated into a fairly coherent mass. In order to free it from the flint the ware is frequently submitted to a process called flat-knocking—*i.e.*, a shaking or knocking process by which dense clouds of dust are produced. A machine process has recently been introduced, in which the flat ware is removed from the saggers to cradles, which are placed in a reciprocating sieve working in an enclosed chamber, to which exhaust is applied. The flint is separated from the ware, and is sifted into a sifted-flint ark below, the same machine being also used for flint-sifting. The cradles are then removed to a stage, and the ware transferred to baskets for removal to the warehouse.

Two determinations were made in the case of machine process and one in that of the hand process. In the machine process dust escapes from the door of the enclosed chamber when the cradles are being removed, and more is produced when the ware is being transferred from the cradles to the baskets. The determinations showed that at a point where the operator stands to remove the cradles from the machine, there is present per 1,000 cubic feet of air 980 milligrams of dust (No. 41), while over the stage where the ware is transferred to baskets there is 968 milligrams per 1,000 cubic feet of air (No. 42). In the determination in the case of the hand process (No. 43), where no exhaust was applied, no less than 16,600 milligrams of dust were present per 1,000 cubic feet of air. In fact, it was difficult to see the worker for dust.

It would appear advisable that;—

(1) All flat-knocking should be done in a machine which is entirely closed during the process.

(2) The machine should be fitted with exhaust in such a way that an inward current of air is induced at every opening.

(3) The ware should be handled as seldom as possible. In this connection it may be said that the machine referred to is more or less in the experimental stage, and it is a fault that the cradles must be taken out of the machine and the ware removed to baskets. It would be much better for the cradles to be removed straight from the machine to the biscuit warehouse. If done as at present, the stage on which the ware is placed in baskets should itself be provided with exhaust.

China Scouring.

On removing china biscuit from the flint in which it has been fired much is found adhering strongly to the biscuit. Its removal is a necessity, and in

order to accomplish this it is scoured—*i.e.*, the ware is held against a rapidly revolving brush, and much dust is evolved. A more recent method of scouring is by means of a machine. The ware is placed in cradles, which are fitted into a large revolving cylinder provided with exhaust, and containing a considerable quantity of china biscuit or "pitcher," broken into small pieces. After the former process, it may still be necessary to submit the ware to a further brushing by hand—this is called fine brushing or finishing. In the machine process this is unnecessary. Two determinations (44 and 45) were made in the case of the machine process, one in that of scouring by hand (No. 46), and one in finishing or fine-brushing (No. 47).

In the machine process the dust found at the centre of the room was 300 milligrams per 1,000 cubic feet of air, while over the tubs where the ware is placed in cradles it was 275 milligrams, the average being 288 milligrams. In the former case the ware was freshly drawn from the ovens, and was therefore dusty, while in the latter the determination was made on the day after the ware had been drawn, so that it was somewhat less dusty. In the hand scouring processes the dust at the breathing point of a girl working before a hood with excellent exhaust was 398 milligrams per 1,000 cubic feet of air, while in fine-brushing the air at the breathing point of the girls working before a moderate exhaust (without hoods) contained 573 milligrams per 1,000 cubic feet.

In the machine process no dust can escape from the machine, and all that is produced comes from the handling of the ware, *i.e.*, in removing it from the baskets in which it is brought from the ovens or flat-knocking room and placing it in the cradles.

In the room in which the determinations in the process of scouring by hand were conducted the scouring was done along one wall, and the exhaust provided was very good. Along an adjacent wall was the finishing bench, and here the exhaust (a branch from the scouring exhaust) was not good, the current of air being somewhat low, and no hoods being provided. The effect was that the dust produced in finishing tended to travel across the room to the scouring bench, at which all the dust produced by scouring was well removed. The whole tendency of the air in the room was to travel towards the scouring bench. Hence, the scourers, though they had all the dust caused by themselves removed, had to breathe that produced in handling the ware (the production of which would be approximately the same as in scouring by machine), and some of that produced by the finishers. This was an excellent instance of a good exhaust partially spoiled by want of efficiently arranged air inlets. It would appear from the results that there is very little difference between the quantity of dust inhaled by the scouring machine attendants and scourers by hand provided with efficient exhaust. The marked effect of exhaust is shown by the result of determination 47 (finishing). There is very much less dust produced in finishing than in scouring, yet in the latter process, where the exhaust was good, the girls were breathing only two-thirds of the dust breathed by those working at the former, where the exhaust was bad, and was overwhelmed by the superior scouring exhaust.

It will be seen that the dust present in the air of china scouring shops, even where that produced by the specially dusty operation is removed, is considerably greater than in the average potters' shop. It is produced in handling the ware, and I can suggest no means of modifying it. There should, however, be efficiently arranged air inlets, so placed that the fan can get its supply of air close to the point of dust production. Probably the quantity of dust in the general atmosphere of the room could be lowered by efficient general ventilation, which would have its normal effect, provided there were proper air inlets to admit air for the fan.

Brushing of Biscuit Earthenware.

Earthenware biscuit, as distinguished from china, is fired in sand, and on its removal, after firing, has some amount of sand adhering to it. This is removed by brushing, and the process bears some analogy to scouring of china. Much dust is produced, the amount present per 1,000 cubic feet of air being shown in one case (by determination 48) to be 1,660 milligrams. A point noticed in this process was that all the workers had bleeding sores on the fingers, caused by friction against the ware. The dust was irritating; most of the operatives were coughing, and their hair and clothing were covered with dust.

Hence it would appear desirable that:—

(1) Local exhaust should be applied to all earthenware brushing done continuously and on a large scale.

(2) Air inlets properly arranged with reference to the exhaust should be provided.

(3) Overalls should be worn.

Workplaces in which Lead is Used.

The method of estimating the total amount of dust in the atmosphere in workplaces in which lead is used was the same as in those where no lead is used. After drying and weighing the filters, the following method, devised by Mr. Vernon Harcourt, for estimating the quantity of lead in the dust, was adopted. With a few small modifications, it was found to be very accurate where no interfering metals were present.

Solutions required:—

Nitric acid.—One part of pure concentrated nitric acid to three parts of water.

Caustic soda.—100 grams of pure caustic soda dissolved in 250 c.c.'s of water.

Sugar.—A saturated solution of sugar in water.

Sulphuretted Hydrogen.—A saturated solution of sulphuretted hydrogen in water.

Coloured Solution.—Cotton wool dissolved in concentrated nitric acid and evaporated to dryness, and the residue dissolved in a little water and filtered—the solution is deep yellow in colour.

Standard Lead.—A solution of lead acetate or lead nitrate made up to contain exactly 0.0001 gram of lead per cubic centimetre of solution.

The bulk of the dust in the filter was removed to a beaker (No. 1) by gently tapping the inverted funnel. The cotton wool was then removed from the funnel, and the upper one-third containing the remainder of the dust was cut off and added to the dust in beaker No. 1. The remainder of the cotton wool was placed in a second beaker (No. 2), 2½ c.c. of hot nitric acid was dropped on the dust in beaker No. 1, from a pipette, a little water added and the whole heated. The solution was filtered into a 50 c.c. Nessler glass, and the liquid remaining in the cotton wool also removed by squeezing the wool with a glass rod against the side of the beaker. The cotton wool in beaker No. 2 was similarly extracted with 2 c.c.'s of nitric acid, and the solution added to that remaining in beaker No. 1. The liquid was heated, the cotton wool macerated in it and filtered as before. The wool was then washed with hot water about three or four times and the liquid filtered into the Nessler glass. A number of standards were then made up by running into Nessler glasses from a burette, varying amounts of standard lead solution covering a fair range. Usually five standards were made up containing 0.5, 0.8, 1.0, 1.2, and 1.4 cc. lead solution, depending on the volume of air aspirated and the quantity of lead expected in the known weight of dust found. To each standard 4½ c.c. nitric acid was added, and 5 c.c. of the caustic soda solution and 4 c.c. of the sugar solution were run into all the six solutions, *i.e.*, one test and five standards, from pipettes. It was invariably found that the test was coloured faintly yellow, and if this is not allowed for in the standards, high results are obtained. Hence a drop or two of the coloured solution (see solutions required) was added to the standards placed on white paper till they matched the test. Lastly, to the contents of each of the six glasses was added 4 c.c. of sulphuretted hydrogen solution, and the liquid in each made up to the 50 c.c. mark, and the whole well stirred. Usually it was found that the colour of the test came somewhat deeper than that of one standard,

and a drop or two of lead solution was added to the standard till its colour matched that of the test. The elaborate method of making up a number of standards was adopted because it was found that any other way gave high results. In the way described many trial experiments were made, and they were invariably correct within half a drop of the standard solution.

Dipping.

The process of dipping is a wet one, the glaze being held in suspension in water in a tub. The biscuit ware is immersed in the glaze, rapidly shaken to free it from excess, and placed either on a board for removal to the drying room or stillage, or direct on the mangle.

Thirteen determinations were made in dipping-rooms. In most cases the filter was suspended over the side of the tub, generally somewhat above the breathing level of the dipper, and with the inlet turned away from him in order to avoid splashing. Of the thirteen, one (No. 61) was in a factory where practically leadless glaze is used, and though the total dust in the air was considerable, the quantity of lead present was so small as to be incapable of estimation. One (No. 60) was in a factory where glaze of very low solubility in acids was used. Here again the total dust in the air was considerable (120 milligrams per 1,000 cubic feet of air), but the proportion of lead soluble in dilute nitric acid was small (2.0 milligrams per 1,000 cubic feet of air). In four determinations (Nos. 49, 50, 51, and 52) no dipping-boards were used, the ware being placed directly on the mangle. The average amount of lead found present in the air in these four experiments was 5.12 milligrams per 1,000 cubic feet. Four determinations (Nos. 54, 57, 58, and 59), under conditions comparable with those where the ware was placed on the mangle, were made where dipping boards were used, the average amount of lead found being 10.62 milligrams per 1,000 cubic feet of air. The boards used were, in every case, dirty—*i.e.*, had much glaze from previous use adhering. Frequently when the boards were moved a small cloud of dust was seen to be produced. The only radical difference between the two sets of four determinations was in the use of boards in one case and not in the other. Hence there can be no doubt that the use of dirty dipping boards is productive of much lead dust in the air breathed by the dipper and his assistants, the quantity probably averaging about 5.5 milligrams of lead per 1,000 cubic feet of air, this being the difference in the average amount found in the experiments where boards were and were not used. In one factory the conditions permitted of a direct attempt to apportion the dust in the air between the boards and other sources. The dipping tub in this factory (determinations 57 and 58) was situated in such a way that the dipper faced a current of air, the boards being placed, parallel to the direction of the current, on one side of the tub, and the ware to be dipped on the other. Hence the dust produced from the boards on one side would not greatly affect the purity of the air on the other side. In determination 57 the filter was arranged over the side of the tub near the boards, and the quantity of lead present in the air was found to be 11.17 milligrams per 1,000 cubic feet. In No. 58 the filter was placed in relatively the same position on the other side of the tub, and the lead found was only 7.14 milligrams per 1,000 cubic feet of air. The conditions were similar, though ware cleaning was being done at the other end of the room during 58, but not during 57, and one man less was working in the room in 58 than in 57. The results would appear to indicate that at least 4.0 milligrams of lead per 1,000 cubic feet of air originate from the boards.

The sources of lead in the air which might account for that found in those determinations where no boards were in use, appeared to be as follows:—(1) Use of dirty appliances, *e.g.*, dipping tub, splash board, and front of mangle having dried splashes of glaze adhering, from which dust might arise, due to rubbing by clothing, etc.; (2) dust brought by the current of hot air from the mangle; (3) use of dirty or dusty overalls; (4) fine spray from the shaking of the ware in the dipping tub. The construction of the dipping rooms in all the four experiments was similar, the rooms in each case forming a cul-de-sac, with the mangle (having an open front), on one side, and the dipping tubs arranged along its front. In each case the room opened into the biscuit warehouse. In determinations 49 and 50 the appliances in use were not clean, but could not be described as very dirty, while in 51 and 52 the mangle front had been newly faced with wood and was quite clean. The dipping tub and vessels were washed before and also at intervals during these determinations (51 and 52). The vessels were, however, of plain wood somewhat worn, and hence they could not be got quite clean. In determinations 49 and 50 the general air currents were from the biscuit warehouse, over the dippers, into the mangle, though the current was much more powerful in the case of 50. In Nos. 51 and 52 the current was strongly and steadily outward from the mangle (cf. temperatures). In 53 the filter was placed directly in this current of air, and the only possible source of lead was the ware on the mangle in course of being dried. The quantity found was 1.94 milligrams per 1,000 cubic feet of air (53). Deducting this from the average quantity of lead (5.52 milligrams per 1,000 cubic feet of air) found in determinations 51 and 52 (which were made at the same tub and in the same stream of air examined in 53), the lead due to dipping alone would be approximately 3.58 milligrams, *i.e.*, this quantity appears to be caused to enter the air as spray produced by the shaking of the dipped article. The average amount of lead found in determinations 49 and 50 was 4.72 milligrams per 1,000 cubic feet of air, and hence it would seem that the quantity due to use of more dirty appliances in these determinations would approximate to a milligram of lead per 1,000 cubic feet of air. In all the cases (49, 50, 51, and 52) the overalls used were clean and fairly free from dust, and the floors also were in each case of cement and clean. Hence one is driven to the conclusion that the fine spray produced in dipping is frequently an important source of the lead found in the air in the vicinity of dippers and their assistants. If the dipping is done in bright sunlight it is possible to see the spray dancing high above the dipping tub. The value of a stream of air, *i.e.*, of good positive ventilation, is shown by the results of determinations 49 and 50. In 50, the air current was strongly and steadily moving, partly from the biscuit warehouse (where, on that day, no brushing was being done), and partly from a large open louvre in the roof, over the dipping tubs, into the mangle. In 49 the current also was generally from the biscuit warehouse (where brushing was being done), but was weak and vacillating, and there was no direct ventilation from the outside air. In No. 50 the total dust found was 100 milligrams, and the lead 3.33 milligrams per 1,000 cubic feet of air, while in 49 the total dust was 255.5 milligrams, and the lead 6.11 milligrams per 1,000 cubic feet of air. In determinations 51, 52 and 53, the current of air being strongly and steadily outwards from the mangle, there was practically no possibility for any dust to be present except atmospheric and glaze dust, and the result is shown in the values for the total dust obtained, *i.e.*, 38.8 milligrams in 53 (current of air from mangle), and 40.0 and 40.2 milligrams in 51 and 52 (the same current of air, but after passage over the dipping tub). Experiments 49 and 50 show the dangerous possibilities due to air flowing from one room where there is dust production to another.

In determination 59, Rockingham ware was being dipped, the boards in use were very dirty, and ware cleaning was proceeding close to the dipping tub. The percentage of lead in the glaze is also much higher than in that used for ordinary earthenware. It is, therefore, remarkable that only 6·39 milligrams of lead per 1,000 cubic feet of air were found. In dipping Rockingham, however, the ware is not shaken at all, and this appears to give additional evidence that the spray produced in shaking contaminates the air.

Determinations 55 and 56 were carried out in a dipping room where there was one dipper and one ware cleaner, the dipper doing all the work usually done by an assistant. Hence the work was very slow and the result is shown by the small quantity of lead found. In determination 55 (1·66 milligrams), no ware cleaning was in progress,

but it was being done in 56 (3·33 milligrams lead), the other conditions being the same. The result shows that the dust from ware cleaning may affect the dipper working in the same room to a small extent. It should be noted, however, that the exhaust provided for the ware cleaner in this case was bad.

A source of dust was noted in the practice of stacking dirty boards, on being returned from the placer or ware-cleaner, near the dipper. In many cases the floor became thickly coated with dust from the droppings of glaze from the boards.

In dipping, therefore, the chief sources of dust appear to be:—

(1) Use of unclean dipping boards.

(2) The practice of stacking unclean boards near the dipper.

(3) Use of unclean dipping tubs, splash boards and other appliances.

(4) Allowing splashes of glaze to remain and dry on walls whence they may become disseminated as dust, by rubbing of clothing.

(5) Dissemination of glaze in the form of fine spray due to the violent shaking of the dipped ware.

(6) Use of dirty or dusty overalls.

(7) An outward current of air from the mangle.

It would appear advisable that:—

(1) No boards should be used by dippers except after washing.

(2) The washing should be thorough, and not merely the wipe-over with a sponge, generally noted, which merely distributes the glaze in a finely divided state on the surface of the board.

(3) The dirty boards from the placers or ware-cleaners should not be stacked in the dipping house, but should be stacked in some receptacle containing water, or on a grid over a trough of water.

(4) All appliances used by the dipper, such as tubs, splash-boards, benches, etc., and that portion of the walls, etc., liable to be splashed during dipping, should be painted, and should be washed free from all glaze daily. This washing should also be thorough.

(5) The spray produced in dipping, where the article has to be violently shaken, should be removed by exhaust or some equivalent means.

(6) All dippers and their assistants should wear non-absorbent overalls, *i.e.*, overalls or bibs of such material as leather or macintosh, which will not allow the glaze to collect in the material, and be given out again as dust on vibration.

(7) There should be no outward current of air from the mangle, which, passing over the dried surface of the glazed ware, certainly collects a small amount of dust.

Gathering at the Mangle.

A mangle is a machine by which ware can be carried on shelves arranged on a pair of endless chains moving through a considerable distance of heated air. Wet ware, as it comes from the dipping tub, is placed on the travelling shelves, and on reaching the point at which it is removed from the mangle, is dry. The operation of removing the ware, is termed "gathering."

Three determinations, in which the filter was placed at the breathing point of the gatherer, were made. In the first (No. 62) gathering of flat ware was being done at the end of a horizontal mangle which was in a small room with no inlet for air whatever, except by means of a doorway leading into the dipping house. Immediately inside the dipping house was a dipper, working with two assistants, on one side of the door and on the other a stillage and stack of very dirty boards, which was constantly being added to by the placers, and from which much glaze had fallen on to the floor. The greater part of the small room in which gathering was done was also utilised for stillage room. A powerful fan, moving 1,660 cubic feet per minute, was extracting air from over the gathering end of the mangle, and there was a powerful current of air from the dipping house into the small gathering room, which passed over the girl doing gathering. The result of this arrangement was shown by the large amount of lead dust in the air, *i.e.*, 16.19 milligrams per 1,000 cubic feet. It was an excellent instance of the bad effects of putting in a fan without providing any means of supplying fresh air, the result being that air laden with dust from the boards was drawn from the dipping house. No true conception of the amount of dust usually produced in gathering could be gained by this determination. In the second, however (No. 63), there was no interfering circumstance, though a current of air laden with a quantity of dust passed from the biscuit warehouse and the sagger house into the mangle front. There were here three gatherers gathering at a three-section vertical mangle, and the filter was placed at the second section. The quantity of lead found was 6.30 milligrams per 1,000 cubic feet of air. This determination was, however, made on a vertical mangle, where there is nearly always an inward current of air. In horizontal mangles the current appears to be frequently into the room from the mangle except when air is extracted by a fan. Hence there would, in general, be greater danger from gathering at horizontal than at vertical mangles, other things being equal, because the issuing current of air passes continuously over the highly-dried ware, and becomes, as was shown in determination 53, charged to some extent with lead. The third determination in gathering (No. 64) was carried out in a factory where the glaze used was nearly insoluble in acid; hence, from the point of view of general danger, no conclusions can be drawn from the low results obtained.

In all cases it was noted that the material of that part of the overalls covering the chest from the waist upwards was saturated with dust, and when tapped a cloud appeared, which (probably through the heat of the body causing an ascending current of air) ascended round the face of the worker. In bright sunlight it was also possible to see a cloud of dust produced, which ascended in the same way at every sharp movement. This in general is a grave source of danger, especially in the case of workers crowded together.

Dust is also produced by the friction of the hands against the ware, and by friction of one piece against another. It would be most desirable (if it is practicable) to mix with the glaze some substance, such as a hard gum, which would cause the glaze on the surface of the ware to be hard when dry—at present the faintest rub brings off some of the light floury glaze.

It should be noted that gatherers have to remove the ware, when gathered, to the stillage, or place where it awaits the requirements of the glost-placer, and they usually carry the ware either in a pile leaning against the chest or on boards on the shoulder. In the former case much dust is rubbed off on to the overall, and in the latter any dust on the boards will be in part released and breathed by the workers, and in part will adhere to the overalls.

Hence it would appear advisable that:—

(1) All gatherers should wear overalls, or at all events bibs and aprons of material which will not collect glaze dust—*e.g.*, leather or macintosh.

(2) No boards should be used, except after washing, and they should be washed after every time of use.

(3) No dirty boards should be stacked near the mangle, since any current of air drawn inwards by the mangle would bring dust from the boards towards the gatherer.

(4) The arrangement of the gathering end of every mangle should be such that a current of air passes into the mangle, or exhaust should be applied at this point.

(5) Air inlets properly arranged with reference to the exhaust or to the inward current of air caused by the mangle, should be provided.

Ware Cleaning.

The process of ware cleaning is perhaps the most dangerous of all lead processes. If dipped ware is placed in the saggers without cleaning, it will be found after firing to be cemented to the sagger at any point at which it was touching. Hence cleaning is generally a process of removing the glaze from any part of the ware which is intended to rest on the sagger. Glaze is also removed from any part where, from the shape of the ware, it would collect in firing and form a thick mass. In very high-class

ware the thickened parts formed where the glaze has run down the piece before drying, are also smoothed in cleaning. The operation is done in various ways, *e.g.*, by scraping with a knife, by rubbing two pieces of ware together, by rubbing on wet or dry flannel, by means of a brush, by means of a piece of pointed biscuit, by means of a hairpin, by rubbing the ware on the overall, etc. In all these operations dust is produced. In some cases, *e.g.*, in the manufacture of coarse earthenware, and Jet and Rockingham, cleaning is done before the glaze has time to dry thoroughly. White earthenware also is not so highly dried before cleaning as printed ware, the colours of which tend to run if cleaning is done when the glaze is damp; china, as a rule, is more highly dried than earthenware. The glaze of china, however, generally contains a less proportion of lead.

Altogether twelve determinations were made during the process of ware cleaning. Of these, two (Nos. 71 and 72) were cases where what is known as wet cleaning was being done, *i.e.*, the glaze was not thoroughly dry, and was removed by rubbing on wet flannel. In neither of these two cases was local exhaust applied. In determination 71, where ordinary earthenware was being cleaned, the ware cleaning bench was alongside a stillage, but the ware was cleaned almost as soon as it left the dipper. Nevertheless, the quantity of lead in the atmosphere was considerable (5·0 milligrams per 1,000 cubic feet of air). The danger is, however, very much lessened by such a method of cleaning, as the overall of the cleaner gave out a small amount of dust only when sharply tapped. In determination 72, Rockingham ware (in the glaze of which there is from $2\frac{1}{2}$ to 3 times as much lead as in earthenware glaze) was being cleaned, also in a damp condition and close to a stillage. The results are very similar to those of 71 (allowing for the greater proportion of lead in the glaze), and it was found that 11·66 milligrams of lead were present per 1,000 cubic feet of air. Here again, however, the overalls worn by the cleaners were practically free from dust. Clean boards were always used for the ware after cleaning, but the dipping boards were somewhat unclean. The average amount of lead found in the air in all the 11 cleaning experiments where lead was used was 9·76 milligrams, but excluding one very high result, where the exhaust was exceedingly bad, the average was 7·0 milligrams per 1,000 cubic feet of air. Hence it will be seen that wet cleaning of ware causes less direct contamination of the atmosphere even where no local exhaust is applied, than ordinary dry cleaning when exhaust is applied. A still more important result of wet cleaning, however, is that the overalls keep much freer from dust.

Of the remaining determinations, No. 73 was in a factory where glaze of very low solubility is used, and no local exhaust is provided. The total dust found was 162 milligrams and the lead 4·05 milligrams per 1,000 cubic feet of air. This, in spite of the fact that much dust was obviously produced by cleaning, was the lowest result noted, except in the case of determination 76, where practically leadless glaze was used. Of the determinations in earthenware cleaning, three (Nos. 65, 66 and 70) were in white ware, and three (Nos. 67, 68 and 69) in printed ware cleaning. The average amount of lead found per 1,000 cubic feet of air in the case of white ware was 4·4 milligrams, and in that of printed ware was 9·1 milligrams. As before noted, white ware is not so highly dried as printed ware. Determination 66 was a repeat of 65, and the results are remarkably similar. No. 68 was also a repeat of 67. In all dry ware cleaning, as in gathering at the mangle, it was noted that the material of the overalls of the workers became saturated with dust about the breast and waist. One case was noted in which a ware cleaner went into the open air during a high wind, and to leeward of her for a considerable time there was a large cloud of dust.

Regarding the different types of hoods and exhaust used in ware cleaning, it is difficult to draw any definite conclusions. It should, however, be noted that the highest results were always obtained where, from the nature of the hood or exhaust provided, or for other reasons, the ware cleaning was done outside the current of air caused by the exhaust, *e.g.* in determination 69 (8·26 milligrams lead) the girl cleaned the ware along a length of about 4 feet, while the exhaust opening (a grid) was 2 feet wide. In Nos. 65 (4·58 milligrams lead) and 66 (4·54 milligrams lead), the cleaning was always done in close proximity to the grid, the exhaust being of an exactly similar type as that of 69. The current of air through the grid was, however, much greater in the latter case, while the ware was not so dry. In determination 75 the ware was cleaned quite outside the hood provided, the shape of which necessitated the board being placd end on to it, so that ware was sometimes cleaned at a distance of 6 feet from the point of exhaust. The result is shown in the high quantity of lead found (37·7 milligrams per 1,000 cubic feet of air). Unclean boards were also stacked close by, and dust could frequently be seen travelling towards the feeble exhaust provided, and over the ware cleaner.

It would appear advisable that:—

(1) Ware cleaning, unless done immediately after dipping, should always have local exhaust applied.

(2) Air inlets arranged properly with reference to the exhaust should be provided.

(3) Boards should not be stacked after use near the ware cleaning exhaust.

(4) All boards should be washed after every time of using, and should only be used after washing.

(5) Overalls of material which does not take up the dust and give it out again, *e.g.*, leather or macintosh, should be used, or a bib and apron of such material, covering the breast, should be worn in addition to the overalls.

(6) Wooden floors should be prohibited.

(7) The form of the hood and exhaust provided should be such that a current of air is drawn over every part of the board, and every point at which ware is cleaned, and should be so arranged that the ware is not cleaned over the boards. (It was noted that very frequently the ware was cleaned in such a way that the droppings fell on to the boards and were subsequently conveyed to the stillage and glost placing benches.)

Stillages and Dippers' Drying Rooms.

After being dipped, the ware in the manufacture of china is dried invariably in a separate drying room. Earthenware is, however, frequently dried on a stillage in the dipping house or ware cleaning room. All ware, after cleaning, is stored till the glost placer is ready for it, on stillages, which also are frequently in the dipping house or ware cleaning room.

Three determinations were made in stillages and one in a dippers' drying room. In the case of No. 77 the stillage was in the dipping room, and ware cleaning was also done in the same room for about $1\frac{1}{2}$ hours (the collection of dust occupied nearly six hours). The direction of the air currents was over the stillage towards the dippers, of whom there were two, also towards the ware cleaning, so that these processes could not affect the result much. Dust from a stack of boards, however, passed across the stillage. The result showed the presence of 9·63 milligrams of lead per 1,000 cubic feet of air. In No. 78, the stillage was in a large dipping house, in which a strong current of air was passing over the stillage towards the mangle, and there was no possible source of dust except from the placing of the boards of ware on the racks, and their removal, both of which were constantly being done. The lead found in the air was 5·47 milligrams per 1,000 cubic feet. In No. 79, ware cleaning was done in the same room for $2\frac{3}{4}$ hours out of the 5 hours occupied by the aspiration, but here again the filter was purposely placed in the current of air from the stillage to the ware cleaning bench. The lead found was 3·50 milligrams per 1,000 cubic feet of air. In No. 80 the filter was placed in the centre of a dippers' drying room, in which louvres in the roof and the heat from the steam pipes caused an ascending current of air, and in which no process but drying was carried on. The boards of ware were constantly being

placed on and removed from the stillage, and the amount of lead found per 1,000 cubic feet of air was 3·06 milligrams.

There can be no doubt that dust containing lead is produced either from the use of unclean boards or from movement of the dried ware in the stillages; and, in those cases where other processes are carried on in the same room, this will affect the workers, especially those at ware cleaning benches, etc., where the exhaust causes a current of air to pass from the stillages over the workers in front of the exhaust hood. How far this production of lead dust could be prevented by use of clean boards, and how far its carriage in a current of air caused by exhaust could be modified by air inlets properly arranged with reference to the exhaust, it is impossible to say. The fact, however, of lead dust being found in all cases to a very appreciable extent in the air of stillages makes it advisable that they should be effectually separated from any part of the factory in which any workers are employed at other processes.

Glost Placing.

The operation of placing the ware in saggers after dipping is termed glost placing. This is usually done in the sagger house, near the ovens, the ware being fetched as required from the stillages by the glost placers, who usually work face to face on opposite sides of a bench, the middle being fitted with a rack for holding boards. The boards on which the ware is carried are nearly always dirty, either from glaze which has run off the ware before it has dried, or from dust and particles of glaze dropped in cleaning. Particles of glaze are also dropped on the bench from the ware itself, and dust is probably produced in handling the dry ware.

In all, five determinations were made in the case of glost placing, but one was in a factory where only one glost placer was employed, so that there was very little activity in the work. In this determination also (No. 85) the ware was very well cleaned, and only 0·92 milligram of lead per 1,000 cubic feet of air was found. The average amount of lead found in the remaining four experiments was about 5·2 milligrams. It was noted that glost placers' overalls were very dusty about the chest, as in case of gatherers and ware cleaners.

It would hence appear to be advisable that in glost placing:—

(1) Exhaust should be applied at the back of the placing bench.

(2) A bib and apron of material which would not absorb dust should be worn.

(3) The boards used should be placed in a receptacle containing water, or on a grid over a trough containing water, and not on the floor after being emptied by the placers.

Drawing Glost Oven.

One determination was made in which the filter was placed in the glost oven while the saggers were being removed, opinions having been expressed that fumes containing lead were given off during drawing when the saggers are opened. To test this theory the air after passage through the filter was drawn through a solution of sodium sulphide. No change took place in the solution, and no lead was found in the dust collected in the filter, which amounted to 168 milligrams per 1,000 cubic feet of air. The temperature in the oven was about 95° Fahr. at a point half-way between the wall and the centre of the oven on the axis at right angles to that from the door to the back of the oven.

Tile Dipping and Cleaning.

In the manufacture of tiles the biscuit is dipped in glaze, and is generally cleaned at once by scraping the edges with a knife. The glaze is thus damp, though it dries very much more quickly than in the case of ordinary earthenware or china.

Two determinations were made, in which the filter was placed between the dipper and tile cleaner. In one (No. 87) the dipping house was an exceedingly good one, the floor being tiled, and the lead found in the air was 5·75 milligrams per 1,000 cubic feet. In the other case (No. 88) the dipping house had a wooden floor and was in other respects not so good. The dust found contained 11·66 milligrams of lead per 1,000 cubic feet of air. Hence, even under good conditions, the lead in the air reaches a considerable amount, while under bad conditions it is above the average for dipping, and also above the average for ware cleaning. The overalls of the tile cleaners, and to some extent of the dippers, were dusty.

It would, therefore, appear to be advisable that in tile dipping and cleaning:—

(1) Wooden floors should be prohibited.

(2) Local exhaust should be applied to the cleaning, with air inlets properly arranged with reference to the exhaust.

(3) Overalls, or at least a bib and apron, of material not capable of absorbing the dust, should be worn by both dippers and cleaners.

Majolica Painting.

In the manufacture of tiles, and also in that of earthenware, it is sometimes necessary to fill in a pattern with different coloured glazes. This is done by painting the glaze on with a small brush or pencil, and is called majolica painting. One determination (No. 89) was made, in which the filter was placed at the centre of a large majolica painting shop, where tiles were being painted. In this case, after a number of tiles had been painted, the paintresses cleaned them by scraping the edges with a knife. The room had a wooden floor, and the dust found contained no less than 25·8 milligrams of lead per 1,000 cubic feet of air. At the conclusion of the collection of dust from the air a sample of dust was swept up from the floor, and on analysis was found to contain 12·15 per cent. of lead. Part of the dust in the air, no doubt, originated from the floor, the traffic in the shop being very great. Bearing in mind, however, the results shown in the experiments on tile dipping and cleaning, there can be no doubt that some originated during the cleaning. In many cases it was noted that the overalls worn by the paintresses were dusty about the breast, giving off a cloud of dust when tapped. Hence, it would be advisable that in majolica painting shops:—

(1) Exhaust with air inlets properly arranged with reference to it should be locally applied to the cleaning.

(2) Wooden floors should be prohibited.

(3) Overalls of material which does not take up dust should be worn.

Conclusion.

The most scientific way of regulating a dusty trade would be to impose a limit on the amount of dust which may be allowed to contaminate the air breathed by the workpeople, and to leave the manufacturer a completely free choice of methods by which this result may be attained. If such a regulation were to be adopted, the occupier of a factory would become liable to a penalty in such cases as it was found, experimentally, that the limit was exceeded. There is nothing inherently impossible in such a regulation. It would, of course, impose on the Factory Department the duty of constantly testing the air in such trades as are scheduled as dusty. In this connection it may be pointed out that the final and only proper test of the efficiency of any method of dust prevention or removal is the state of the atmosphere in the workroom in which such a method is applied. It is impossible to draw any really accurate conclusion, either from seeing the room, or from such tests as can be made, for example by anemometer in the case of exhaust. One exceedingly good instance of this was furnished in the course of the inquiry. In one shop (determinations 8 and 11) the conditions appeared exceedingly bad to the eye, though exhaust, which also appeared very faulty, was applied. In another case (determination 7), in which exactly the same process was carried on, the conditions appeared exceedingly good, and the exhaust applied appeared very effective, yet on testing the air by experiment, approximately the same amount of dust was found in each case, and there was very little to choose between the two shops as far as purity of atmosphere is concerned. Great simplification of the regulations would result if such a course were adopted.

Similarly, in the case of workplaces where lead is used, a regulation providing that at no time shall the lead present in the air exceed a certain

limit, would do away with the necessity for regulations directing in detail what shall be done in certain cases, *e.g.*, in dealing with boards, etc. In order to suggest the advisability of making such regulations, however, it is necessary that:—

(1) A full knowledge of the conditions of manufacture is obtained experimentally.

(2) An accurate method for the quick and easy determination of the dust in the air, and of the lead in such dust, is available.

It cannot be said that the investigation is sufficiently complete to enable any limit, either of dust or lead, to be definitely fixed. The experiments have been too few in number, and have only taken place in the winter months, when possibly the dust in the air is considerably less than in the summer. I do suggest, however, the advisability of aiming at such a method of controlling the dusty trades.

The time placed at my disposal has been too short to do more than touch the fringe of a very important subject, although I hope that the results obtained will be of value to the sub-committee.

I desire to express my gratitude to Mr. Vernon Harcourt and Mr. Burton (members of the Committee), to Dr. Baker, of Christ Church, Oxford, and Dr. Mellor, of the County Temporary Pottery Laboratory, Stoke, for much kindness and assistance during the investigation, to those manufacturers who placed their workshops at my disposal, and also to the workers in those workshops, who were frequently put to considerable inconvenience.

G. Elmhirst Duckering.

PART II.

Notes on certain of Mr. Duckering's determinations of Dust in Air; with special reference to cubic space and ventilation. By C. R. Pendock, Esq.

Determination 1.—Small tile shop occupied by girl pressers, and not ventilated by fan. The only ventilation was by means of a door and four window-panes (the latter 4 square feet in area), all on one side of the shop. As the day was calm, the air puffed in and out of windows without traversing the room; no cross current. Fire alight, but drawing air from door close by. Floors very dusty; girls' clothing covered with light dust. With door open most of the time even the ventilation was feeble.

Dust, 1,380 mgr. per 1,000 c. ft. 11 workers. Space per head, 852 c. ft.

Determination 2.—Same tile shop as in case of No. 1. On this occasion there were only seven out of eleven girls at work, and there was less activity and commotion. Floors clean swept after weekend. The weather being colder, the door was closed most of the day. Same fire.

Dust, 1,155 mgr. per 1,000 c. ft. 7 workers. Space per head, 1,337 c. ft.

Determination 3.—Similar tile shop to the above. Eight girls were fully employed. There was greater activity and more dust than in the case of Nos. 1 and 2. Fire alight. Ventilation very weak.

Dust, 1,711 mgr. per 1,000 c. ft. 8 workers. Space per head, 681 c. ft.

Determination 4 (see chart 5).—Shop in which large tiles are pressed by men, with boy attendants and girl fettlers. Very irregular shape; adjoins yard on one side, and communicates with dusty rooms on every other side; so that fan tends to import dust from other shops. Floor 3 feet below ground level. A busy workplace with much through traffic, such as youths and men carrying dust and saggers. The principal ventilation is by a 30-inch fan extracting 1,800 cubic feet per minute through a crude duct with eight exhaust slots behind the presses, there being no hoods over the dies. The natural ventilation, however, was considerable; there being four or five doors disposed round the room in a way that made a cross current almost inevitable.

The fan was stopped for this experiment, and the shop was very dusty. The dust filter was placed near presser. Work in full operation, both pressers and fettlers. Men complained that the material was too dry for pressing, and therefore more dusty. The press dies were covered with paper collars, which prevented some dust rising.

Dust, 1,580 mgr. per 1,000 c. ft. 21 workers. Space per head, 515 c. ft.

It is noteworthy that the air contained twice as much dust when the exhaust fans were not in operation.

Determination 5.—Same tile shop as in No. 4. Fewer hands at work; seventeen instead of twenty-one. Filter again placed near presser, who was working in front of exhaust orifice without hood. The fan was extracting 106 cubic feet per head per minute, and the dust was reduced by about 50 per cent. The doors and windows were of large area, and were nearly all open during the test.

Dust, 750 mgr. per 1,000 c. ft. 17 workers. Space per head, 636 c. ft.

Determination 6 (see chart 1).—A very well arranged tile shop in which heavy press work (of similar character to that carried on in the last-named shop) was done by men pressers with boy attendants and girl fettlers. The machines and benches are fitted up admirably for economising space and keeping the shop clean; and their disposition over the floor area is also good, so that local ventilation applied to each press also affects general ventilation that can be shared equally by all occupants. Unfortunately, the exhaust ventilation is somewhat spoilt, chiefly because the ducts are much too small for the powerful fan, and there are many right-angled junctions; and the general ventilation is marred by the fresh air inlets being nearly all at one side of the building. The presses are fitted with well formed hoods, and the current at each, though not extremely powerful, is well concentrated on the dust point. Only one of the fettlers was provided with exhaust; and although the hood was not perfect, the exhaust was found to be beneficial. The determinations of dust show that exhaust is necessary for all tile-fettlers. The fresh air inlets consist of louvres in the ridge of the roof and windows at one side only of the shop, providing little cross ventilation. These windows at the time of the test were open to the total extent of 5 square feet, and air entered at a velocity of 500 feet per minute; thus admitting 2,500 cubic feet per minute, or nearly as much air as the fan extracted in the same time. The roof louvres were very slightly opened on the wintry day when the determination was made, because men complained of cold down draughts.

Although most of the air was extracted through the press hoods, there were two other openings in the duct near the fan which contributed to the general ventilation; the press exhaust amounting to 70 c. ft. per minute per head, and the total ventilation to 103 c. ft. per minute per head.

Dust, 543 m.g.r. per 1,000 c. ft. 30 workers. Space per head, 515 c. ft.

Note.—An observation was made on a cold morning when windows and louvres were all closed. It was then found that the fan drew air from all the adjacent rooms whenever their respective doors were open, *i.e.*, from the drying stove, dust ark, and small tile room, importing dust in the process. It would be a great advantage in cold weather if the entering air could be introduced through some channel in which it could be tempered and controlled, and admitted in sufficient volume to prevent dust being sucked from other rooms.

Determination 7 (see chart 2).—Another well arranged and well equipped shop in which small tiles are pressed by girls. This shop adjoins the last mentioned and could be thoroughly ventilated by improvement in the exhaust plant, the ducts of which are so small and have so many incorrect turns and junctions that the efficiency of the local exhaust is reduced to nearly 15 per cent. of its theoretical maximum. A large opening in the fan box more than doubles that efficiency for general ventilation purposes; but as the fan is at one end of the shop (immediately over one door and not far from another) there may be much short-circuiting. Most of the inlets for fresh air are in a raised "lantern" placed lengthwise along the ridge of the roof, and on the wintry day when this experiment was made, these were closed; so that air could only be drawn through the outer doorway (seldom opened), or from

adjoining rooms, *i.e.*, the tile press room or drying stove at end. During the test most of the air seemed to come from the latter.

The fan extracted 53 cubic feet per minute per person for local effect, and 112 for general effect.

Dust, 517 mgr. per 1,000 c. ft. 28 workers. Space per head, 404 c. ft.

Determination 8 (see chart 3).—A larger shop in which girls were pressing small tiles. Mechanically ventilated; but the exhaust was badly applied, there being no hoods over point of origin of the dust, but merely a slot some distance behind each press. The effect was therefore general rather than local; the more so as the exhaust orifices were fairly well distributed round the shop, so that the ventilation, such as it was, was felt by all occupants. Walls—rough masonry Roof—rough unceiled joists. Woodwork, such as ducts, benches and racks—all of crude formation. Shop had the appearance of being very dusty and dirty. The fresh air inlets were extremely meagre, consisting of small window panes and one chimney, in all about 1·2 square feet; these operated as inlets only when the fan was at work. Most of the air was drawn in from an adjoining press shop equally dusty. When the fan is stopped there is practically no ventilation in this shop; but the fan power, though poorly applied, is sufficient to change the air about 12·6 times per hour.

Dust, 463 mgr. per 1,000 c. ft. 23 workers. Space per head, 330 cubic feet.

Determination 9 (see chart 5).—Same tile shop as in case of No. 4, the filter being placed near a fettler with no exhaust; fan stopped and ventilation depending upon natural means. The girl was fettling six-inch tiles, and the room generally appeared to be very dusty, although there was considerable natural ventilation. It will be seen from the results that the amount of dust is extraordinarily high, the general ventilation apparently having no effect in the absence of exhaust.

Dust, 4,550 mgr. per 1,000 c. ft. 17 workers. Space per head, 636 c. ft.

Determination 10 (see chart 3).—Dust filter placed near fettler. No mechanical exhaust in room. Dust in air considerable, though only few hands at work.

Dust, 1,233 mgr. per 1,000 c. ft. 9 workers. Space per head, 846 c. ft.

Determination 11.—Same shop as above, on another day, the dust filter being placed near same fettler. In this case, however, a mechanical exhaust was in operation extracting air through a slot about 18 inches behind the press. More hands at work; also some extra dust being caused at the time by sagger carriers. It will be noted, on comparing the result of this determination with that of No. 10 above, that the dust in the air was reduced to less than half when the exhaust current (poor as it was) was in operation, although the space per head was little more than one-third of that noted at the time of determination 10.

Dust, 492 mgr. per 1,000 c. ft. 23 workers. Space per head, 330 c. ft.

Determination 12 (see chart 1).—Same large tile shop as in case of No. 6, on same afternoon; the filter being placed near a fettler having no special local exhaust provided for her, exhaust, however, provided at the presses.

Dust, 600 mgr. per 1,000 c. ft. 30 workers Space per head, 515 c. ft.

Determination 13.—Same large tile shop as in case of No. 12, on same afternoon, but the dust collection made near a fettler for whom a special exhaust opening was provided. It will be noted that the dust is less than half that collected where the local exhaust was not applied.

Dust, 250 mgr. per 1,000 c. ft. 30 workers. Space per head, 515 c. ft.

Determination 14.—Same shop as in case of Nos. 1 and 2. Filter placed in centre of shop for estimation of dust in general air. Cold weather, doors shut most of day, and ventilation very feeble. Same fire. It is interesting to note, in comparing the result of this experiment with that of No. 2, that the general air is only about a third less dusty than the air near the press, other conditions remaining the same.

Dust, 815 mgr. per 1,000 c. ft. 7 workers. Space per head, 1,337 c. ft.

Determination 15.—Same tile shop as in case of No. 3; but with filter in centre of room. Poor natural ventilation.

Dust, 977 mgr. per 1,000 c. ft. 8 workers. Space per head, 681 c. ft.

Determination 16.—Same tile shop as in case of Nos. 8, 10, and 11. Fewer girls at work than usual (7 out of 23). Filter placed in centre of shop to test general air. Fan stopped entirely all the afternoon; practically no ventilation, the air inlets remaining inoperative when the fan was stopped. End door open to next tile shop for about 1¼ hours, during which time six men were carrying out saggers. Some girls had placed paper collars over the dies, and these kept some of the dust from rising.

Dust, 1,343 mgr. per 1,000 c. ft. 7 workers. Space per head, 1,087 c. ft.

Determination 17.—Same tile shop, but more nearly the normal number of girls at work (15). Filter placed in centre of shop. Fan running; floor less dusty, and less traffic with saggers, etc.

Dust, 173 mgr. per 1,000 c. ft. 15 workers. Space per head, 507 c. ft.

Determination 18.—China potters' shop. Cup-making. A small, somewhat long and narrow potters' shop, in which the processes were mostly wet and little dust was given off, but in which the atmosphere was very close and oppressive, although the potters said it was cooler on the day of the determination than for months previously; temperature in centre of shop 28° over that of the outside air. Heat due to drying stove placed whole length at one side of this long, narrow room, and occupying one-tenth of the space. No through ventilation except when doors open, at which time cool fresh air enters door at one end, and several holes at ceiling level act as outlets for hot air. Change of air sluggish and intermittent, and ventilation bad in spite of breezy conditions outside.

Dust, 223 mgr. per 1,000 c. ft. 6 workers. Space per head 661 c. ft.

Determination 19.—Another china potters' shop; fairly clean, large, and lofty; has plastered ceiling, and is almost airtight when doors and windows are closed, as they were at the time of the determination. Cold, dull, and misty outside. Ventilation extremely deficient; in some shops a small amount of fresh air is continually introduced from the outside by persons constantly coming through an open door, but in this case there was very little passing through the only entrance, and no appreciable ventilation resulted from this source. Shop has clean and good brick floor, and is probably unhealthy more from excessive heat and bad ventilation than from dust. Temperature, 67° (or 29° above outside). Occupants, being youthful, are apparently healthy, but are somewhat pallid and languid towards end of day. All the windows were closed, and the ventilation depended upon six perforated air bricks. Change of air by natural means probably not more than once in five hours.

Dust, 246 mgr. per 1,000 c. ft. 20 workers. Space per head, 648 c. ft.

Determination 20.—An earthenware potters' shop; cup-making and handling. Filter placed at centre. A hot stuffy shop; practically no ventilation. Much activity, but apparently little traffic of a type likely to stir up dust. The edges of cups are cleanly pared off in the wet clay and there are no ragged edges to be scrapped when dry; consequently, floor is not covered with scraps of dry clay to be trampled into dust. All windows shut, and ventilation depends on eight perforated air bricks.

Dust, 191 mgr. per 1,000 c. ft. 9 workers Space per head 403 c. ft.

Determination 21.—Another earthenware potters' shop, towing and handling being done as well as dish, cup and plate making. Filter placed at side of shop. Outside weather dull, very mild, with soft south breeze; very hot and oppressive atmosphere inside. I personally found it very exhausting and enervating. Temperature inside, 67° wet and 74° dry bulb as compared with 46° and 50° outside. Constant flow of hot air, 84° wet and 108° dry bulb, from six stove doors. The four

ventilating outlets from the drying stoves to the outside air were all closed, and the hot air passed through the working area before escaping to the open, a wrong direction altogether. Few windows were open, because the difference of 30° in temperature made draughts uncomfortable, and no means were provided for tempering the incoming air; besides which, the open windows are too conspicuous, for when the workers see a window open they imagine a draught, whether there is one or not. The dust collection was made in the narrowest and most crowded part of the room, and the result probably represents more than the average condition for the whole shop. Three fans were in operation and the towing and fettling were done under hoods. The fans being small, their output totalled about 860 cubic feet, or 28 cubic feet per person per minute. The natural ventilation was effected by capacious fanlights and three doors.

Air changed by fans about 2·6 times per hour and by natural means about 11 times per hour.

Dust, 450 mgr. per 1,000 c. ft. 31 workers. Space per head 640 c. ft.

Determination 23.—Earthenware potters' shop; plate-making. A busier and much more fully occupied shop than in the case of 19; and, owing to the trampling on dry clay scraps dropped from the moulds, it would be very much more dusty but for the large amount of natural ventilation. Owing to the large volume of hot air emitted from the drying stoves, six doors of which are always open, the atmosphere was very hot and oppressive, 28° above outside air, the weather being dull, cool, damp, and calm. The effect on my own person was a painful headache and lassitude at the end of two hours or so. Workpeople seemed healthy, but are all youthful. The means of natural ventilation are so ample as to be almost excessive; but the air currents are all encouraged to move in a wrong direction. Instead of fresh air being brought in from the outside across the working area to reduce the temperature, and pass outwards with the hot air from the drying stoves, the exact contrary is the case. Hot air at a temperature of 82° wet bulb and 104° dry bulb was found to flow out from the six stove doors in a volume of 4,740 cubic feet per minute, all of which passed through the potters' shop instead of finding a direct and independent outlet to the open air. The shop was lighted by capacious skylights, all of which were open, and there was a constant and rapid movement of air through the narrow workplace. There was also a leakage from the discharge duct of an adjoining exhaust fan, which blew in 415 cubic feet per minute. In this and the next determination the cubic space per head was comparatively low, and the low dust result can only be explained by the passage of enormous volumes of air through a narrow room, which is practically a passage.

Dust, 62 mgr. per 1,000 c. ft. 25 workers. Space per head, 336 c. ft.

Determination 24.—Another earthenware potters' shop; saucer-making and towing. Mechanically ventilated. Precisely similar in shape, size, and character to the last shop in same building (No. 23), but much more crowded at time of test; having, in fact, less than the minimum statutory cubic space. A scene of great activity and much traffic liable to cause dust, which probably accounts for the higher result than in the previous case. The means for natural ventilation are much the same; but these are augmented by a fairly powerful exhaust system operated by a 36-inch fan. In summer time the inlets are so large and numerous as completely to "flood" the building with fresh air; but on the day of test (very wet, cold and windy) most of them were closed. Temperature 27° above outside air. The dust collection was made in the best ventilated (central) portion of the shop, between the second and third right hand exhaust hoods. One woman near by was making 2,000 saucers a day, and kept several attendants very busy, running and trampling over dried clay scraps to stoves, etc. The movement of air was more perceptible than in the corresponding plate shop (No. 23), mainly due to suction of exhaust fan drawing a noticeable draught downwards from skylights.

The local exhaust is fairly good in effect, but very wasteful of fan power (efficiency 16·9 per cent.). If the hot air from drying stoves could be carried off by some direct and independent channel to the outside, the ventilation for dust removal would be a far simpler matter, to be easily accomplished with far less air motion. It is the necessity of ventilating for heat reduction which complicates the matter.

Fan extracts about 83 cubic feet of air per person per minute.

Dust, 100 mgr. per 1,000 c. ft. 36 workers. Space per head, 233 c. ft.

Note.—The engineer says that the dust created by towing plays havoc with the whirler bearings and machinery.

Determination 25.—Same saucer-making shop as in case of No. 24.

This determination, made in the afternoon of the same day, took place at a point where the heat was much greater and more oppressive; there being less natural overhead ventilation, and the filter being placed 15 feet from the extreme end of the exhaust duct. Temperature at middle of bench near filter was 69° wet and 77° dry bulb at 3.45 p.m., as compared with 63° wet and 71° dry bulb in the better ventilated spot where determination 24 was made the same morning between two exhaust hoods. There was again a large outflow of hot air from drying stoves. Temperature 104° at stove, upper part of stove door.

Dust, 107 mgr. per 1,000 c. ft. 36 workers. Space per head, 233 c. ft.

Determination 27.—A large plate-towing shop. Filter placed near towing hood with exhaust. Outside weather cold, dull and foggy. The conditions inside are unusual. The whole floor forms the brick cover of a shallow hot water tank, receiving the condensed water from engines, steam coils, etc. Consequently heat rises from the floor and is most uncomfortable for the feet, and women find it unpleasant although they have boards to stand on. The windows immediately in front of the towing operatives have large fall-back lights kept fully open, and the draught from them is chiefly inwards and downwards owing to the exhaust set up by two 36-in. fans. The ventilation, both natural and mechanical, being all ranged on the same side of the shop as the workpeople, the latter get the full benefit of its concentration; but the heating of the floor must cause discomfort to the workers. The extraction of air by fans amounted to 317 cubic feet per head per minute.

Dust, 300 mgr. per 1,000 c. ft. 17 workers. Space per head, 1198 c. ft.

Determination 28 (see chart 16).—Another plate-towing shop. Filter placed near towing hood. The place in which the towing is done is a small compartment roughly partitioned off from a large sagger house, the partition being little more than a screen; so that there is free interchange of air between the large and small divisions. As the large division is bounded by blank walls, however, very little air can be drawn through it towards the towing compartment; and as all the work is done in the latter, the former being unoccupied, the larger air space might almost be ignored. The towing heads are not enveloped with a hood, but have each a large, flat, open grating, level with the bench. As the exhaust currents are not concentrated, they need to be particularly strong to produce the desired result, and are therefore generated by four 18-inch fans operating at high speed through short ducts connected with two hoods each. The total output of the four fans is about 8,300 cubic feet per minute; and as there are no hoods or trunks in which dust can settle, the amount blown out is very large; and it is all discharged immediately under windows and near doors, by which it can and does re-enter the workplace under the influence of the powerful suction. Such excessive air motion makes the workplace very draughty, and renders it difficult to maintain a reasonable temperature in winter. The high rate of exhaust, moreover, does not give satisfactory results, for the air in this shop was no freer from dust than that in the shop where the preceding test was made, and where the extraction per minute per person was little more than one-fifth of the amount.

Dust, 300 mgr. per 1,000 c. ft. 6 workers. Space per head, 720 c. ft.

Determination 31.—Flat-bedding in china works. The process of bedding was carried on here in a large shed built round three ovens. The placers' benches were fixed against the wall nearest the yard; and in this wall were large open doors at intervals of a few feet, through which the outside air was free to enter and pass by the placers almost as in an open thoroughfare, so that the men were working in practically open air and at almost the same temperature as outside. The weather was damp, dull, mild, with slight breeze. At the back of the placers' benches were two ovens, one being set with glost ware and the other with biscuit ware. Two of the doors acted as inlets to the breeze; the oven furnaces and other doors acting as outlets. Consequently, the natural ventilation was considerable.

The occupier and workmen agreed that there was probably less dust arising than usual owing to the dampness of the air and the flint being cold instead of hot. It may also be added that the flint itself was rather coarse and heavy.

Dust, ·485 mgr. per 1,000 c. ft. 8 workers. Space per head fairly large, and difficult to estimate.

Determination 32.—Hollow-ware placing in same works; on afternoon of same day. The conditions as to ventilation and cubic space were practically the same as in No. 31.

Dust, 362 mgr. per 1,000 c. ft.

Determination 33.—Bedding and placing in another china works.

Weather, mild and fine after rainy night, slight south-west breeze.

The flat bedding here was done in a very much smaller shop; warmer and more comfortable; but surrounded by other shops on all sides. As some of the doors led indirectly to the outside air, and an oven was being fired two doors away, there was a fair current of air passing most of the time. There were also three louvres in the roof and a window at one side open to another room. The flint dust in itself was very fine and dry, just sifted warm from an oven drawn the same morning, so the process would be naturally more dusty than where coarser flint was used (as in Nos. 31 and 32). The work was also proceeding more leisurely; so there was less activity and commotion.

There was no local exhaust in this shop, but a fair amount of natural ventilation.

Dust, 571 mgr. per 1,000 c. ft. 10 workers. Space per head, 576 c. ft.

Determination 34.—Drawing china biscuit ware from oven. The dust filter in this case was placed inside an oven which three men were in the act of drawing; and, although not considered an exceptionally hot oven by the drawers, the temperature inside ranged from 64° to 87° wet, and from 82° to 154° dry bulb, according to position. The oven itself was one of 14½ ft. diameter. The fires had been drawn on the previous Friday, and the oven had been cooling till Monday morning—about 48 hours.

Dust, 598 mgr. per 1,000 c. ft.

Determination 35.—Emptying china biscuit ware from saggers at mouth of same oven as above, and on afternoon of same day. Weather bright, fresh and breezy. The place was very open and there was much ventilation through large doorways. The process is very dusty owing to the disturbance of flint dust from saggers containing hot fired flint and biscuit ware; there is also much dissemination of dust from broken saggers, etc. There was no exhaust ventilation, but a good deal of air was set in motion by the still warm oven and the breeze through doorways.

Dust, 1,677 mgr. per 1,000 c. ft.

Determination 36 (see chart 13).—Emptying china biscuit ware from saggers.

This was being done in a very large sagger house having wide archways open to adjoining shops on three sides, with five windows in the only wall directly accessible to the outside air; only one of these windows was slightly open, and the others were all darkened by wooden air ducts, which made the whole shop rather dark to work in. Fresh air found its way in indirectly through doorways of other shops.

A 36 in. fan set up local exhaust through long, crude ducts and throats of very incorrect formation; its object being to extract dust from (*a*) the bedding benches, (*b*) the arc containing sifted flint, and (*c*) the flint sifting machine contained in an annexe.

The total volume of air extracted per minute by the fan was 2,860 cubic feet, or about 238 cubic feet per head; but this had only a *general* effect so far as the determination 36 was concerned, as the filter was placed near work carried on in the centre of the shop, and therefore some distance from the influence of exhaust. The work of removing fired ware from saggers was very dusty, particularly as the flint was warm from the oven (70°) and was fine, floury and light.

Dust, 2,385 mgr. per 1,000 c. ft.

Determination 37.—Emptying flint from saggers. This was a very dusty process occupying one man for an hour or so at intervals; and as the man had to stoop to pour the fine warm flint dust from saggers into boxes for transmission to sifter much of the dust rose in his face, and no attempt was made to draw it away by local exhaust.

Dust, 2,737 mgr. per 1,000 c. ft.

Determination 38 (see chart 11).—Sifting fired flint by machine.

The machine was fixed on a stage about 3 feet high, just inside the door of a large shed, which also had two other doors and a window. Two of the doors and part of the window were constantly open; and, as the place was used as a thoroughfare from one part of the factory to another, the doors were kept open and the shed was thoroughly flushed with fresh air; so much so as to be practically as fresh as the outside, its temperature and condition being almost precisely the same. Weather: fresh, raw and rather bright after rain. The flint sifting machine was well boxed in, and the sifting rocker placed well below the breathing level; in fact lower than the workman's knee. The sifted flint fell into a large ark under the stage, from which it was removed through a shuttered hole on the outside wall, accessible from the yard only. The machine was not fed by a shovel, but the boxes (in which the flint arrived from the newly drawn ovens) were tipped directly into the sieve when at rest; the doors were then shut before starting the machine and kept closed until the process was finished; air was extracted all the while by means of a fan exhausting through a throat in a back corner of the casing. Most of the dust arising inside the building came from the lifting up and down (to the stage) of boxes of flint from the carriers' shoulders, etc. Though a great advance on hand-sifting, this machine is not yet perfect, as it has not emerged from the experimental stage, and the engineers are considering practical improvements. The exhaust was less than 20 per cent. of what it might have been for the same fan power if the full power of the fan had been properly applied, but the outlet is so restricted as greatly to diminish the effect. Another great want is some sort of settling chamber to arrest the dust discharged from the fan which is now blown out in clouds to be scattered over the roof. The air displaced by the fan was 535 cubic feet per minute.

Determination 39 (see chart 11).—Same machine and shop, and on the same day as No. 38; but filter placed at side of machine over bench upon which carriers deposit the flint boxes, instead of over the feeding door of machine, as during the morning. Most of the dust arose here from the handling of flint boxes and transference of dust. Sifting is done for a few hours daily, intermittently with other work.

Dust, 125 mgr. per 1,000 c. ft.

Determination 40 (see chart 13).—Sifting fired flint by a different machine in another works.

The sifting machine consisted of ordinary round sieves, placed on slides and operated by cranks and detachable connecting rods; the whole being covered with a wooden cupboard having wide doors in front and an exhaust aperture at the top leading to a 36 in. fan; the general construction being rather rough. The machine was fitted in a small annexe of the large sagger house mentioned in No. 36, forming a rather dark compartment bounded by blank walls, so that no air could enter except through a doorway leading from the dusty

sagger house itself. The absence of capacious fresh air inlets makes a notable difference as compared with the sifting shed in No. 39.

The dust, whilst still warm, is transferred from saggers to boxes, and the boxes are carried in and emptied over the top of a flint ark placed at right angles to the sifting machines; the dust being retained in the ark by means of loose boards, which can be raised or lowered to suit varying quantities of dust. When this ark is full the operative has to raise his shovel to the height of his head and plunge it into the top of the ark in such a way that clouds of dust are raised with every shovel full; as is also the case whenever a retaining board is removed from the front of the ark. Dust is also scattered from the shovel in passing it across to the sieves, and a large quantity leaks from below the sifter through the ill-fitting framework and drawers.

Much of this falls on the floor to be trampled on by the carriers, etc. The whole apparatus, which is in an experimental stage, is clumsy and inefficient, and the exhaust suction, though strong, does not overcome the constructional defects and airless surroundings of the machine. The space in which it is erected is altogether too confined.

The heat from the flint maintained a temperature in the compartment of 12° above the outside air (64° as compared with 52°). The local exhaust amounted to 850 cubic feet per head per minute.

Dust, 2,650 mgr. per 1,000 c. ft.

Determinations 41 and 42 (see chart 11).—Same works and machine as Nos. 38 and 39. Knocking the flint from flat china ware by machine.

No. 41 with filter over machine door. Dust, 980 mgr. per 1,000 c. ft.

No. 42 with filter over side bench. Dust, 968 mgr. per 1,000 c. ft.

Ventilation much the same as in Nos. 38 and 39.

Flat knocking is a far dustier process than flint sifting, because of very much more handling of ware and disturbance of dust. Articles are placed in flat trays with perforated bottoms, and there is much leakage of dust before these reach the enclosed rocker of the sifting machine, where the fan exhaust comes into operation. The occupier said he hoped greatly to improve the appliances for flat knocking in this machine, although it was already a great improvement on the old hand process.

Determination 43.—Flat knocking by hand.

The general process (of knocking the flint from flat china biscuit ware by hand) was here carried on in the sagger house without any apparatus for intercepting the dust. There was plenty of cubic space, but practically no effective ventilation, and the quantity of dust given off was extremely large as may be seen from the very high result of Mr. Duckering's test.

Dust, 16,600 mgr. per 1,000 c. ft.

Determination 44 (see chart 12).—China scouring by machine.

Weather cool, bright and breezy. Two of Wainsford's machines were operating in a large scouring shop, with large door open at each end; workers constantly passing in and out from yard, so that there was a fairly good through current of air along the side where the least dust was created. On the opposite side of the room a much smaller current of air at a temperature of 110° passed in from the dippers' drying room and across to the machines, the air of the room being warmed by this means.

The machines themselves were ventilated by a 24-inch fan making 710 revolutions per minute; but the fan was very dirty, and the bottle-neck connection from each machine to the duct was so extremely small (being only a 6-in. pipe) that the resultant exhaust was very weak.

The ventilation of these machines can be greatly improved. As made at present, they really require a centrifugal fan, because of the resistances to be overcome in getting a current of air to pass the many internal obstructions contained in the machine; but, unfortunately, they seem to be invariably connected to a propeller fan in a way that still further diminishes the efficiency of the exhaust.

The filter, for this experiment, was in the centre of the room and the air did not seem very dusty for a scouring shop. The fan extracted about 450 cubic feet per minute.

Dust, 300 mgr. per 1,000 c. ft.

Determination 45.—Same shop and process.

The filter for this experiment was placed over the cradle tubs where the machine cradles are filled with ware before being placed in the rumbler for scouring. Ventilation much the same as in No. 44.

Dust, 275 mgr. per 1,000 c. ft.

Determination 46 (see chart 7).—China scouring by hand; the older process; ventilated by local exhaust. The scouring shop was a lofty spacious room with very fair inlets for fresh air; also powerful exhaust by fan, which was, however, most unequally divided between two different benches, and lowered in efficiency to a great extent by incorrect ducts, etc.

Judged merely by the eye, the shop appeared to be fairly clear of dust, but Mr. Duckering's results show that the air is somewhat more dusty than in the shop in which scouring machines were in use. It may be remarked that the shop was very cold and somewhat draughty owing to the continual opening of a door near the scouring benches, which was approached from the landing of an outside staircase, and was therefore rather exposed.

Dust (filtered at a scourer's hood), 398 mgr. per 1,000 c. ft.

Determination 47 (see chart 7).—The same shop as for No. 46; the filter being placed next morning at the fine-brushers' bench. The exhaust at the brushers' bench being so much weaker than at the scourers' bench, there can be no wonder at so much more dust being found in the air.

Dust (at fine-brushers' bench), 573 mgr. per 1,000 c. ft.

Determination 48.—Earthenware biscuit brushing. Lofty and spacious biscuit warehouse with no exhaust and but little natural ventilation except on the unoccupied side, where there was a strong through current from door to door, which had little ventilating effect except in its direct path. A very dusty process, at which girls work in a sitting posture, with their heads bent closely over their work.

Dust, 1,660 mgr. per 1,000 c. ft.

APPENDIX L.

Report on a series of experiments for ascertaining the accuracy of a suggested method* of quickly estimating the percentage of lead contained in the glazes on finished articles made of earthenware and china.

By H. R. Rogers, Esq., M.A., F.C.S., one of H.M. Inspectors of Factories.

The suggested method of estimating the lead was as follows:—

(*a*) Hydrofluoric acid solution is applied to the glaze on the finished piece of ware by means of a quill pen, and is allowed to act on it for a given time.

(*b*) The liquid is then absorbed by means of blotting or filter paper.

(*c*) The paper is then heated so as to drive off any excess of hydrofluoric acid.

(*d*) The paper is immersed in a bath of sulphuric acid, so as to convert the lead compounds into the sulphate.

(*e*) The paper and precipitate are washed in water in order to dissolve out all sulphates which are soluble in that liquid.

(*f*) The paper and precipitate are treated with ammonium sulphide, so as to convert the lead sulphate into the black lead sulphide.

(*g*) The paper and precipitate are dried. It was hoped that by comparing the black stains thus produced with standard stains it would be possible to estimate approximately the percentage of lead contained in the glaze.

Preliminary Experiments.

Since the whole value of the test depends upon the difference in the shade of the deposit of lead sulphide, and since the shades might in some cases differ only to a very slight extent it was considered necessary to know the exact conditions under which each experiment was carried out. Moreover it was necessary to find the most suitable conditions for carrying out the test.

A series of preliminary experiments was therefore made as follows:—

A. Tests to find the strength of the hydrofluoric acid solution.—The hydrofluoric acid provided was—as usual—of unknown strength. It was therefore necessary to experiment with the original acid and various mixtures of acid and water in order to find what was the best solution to use for the final test.

Inasmuch as the hydrofluoric acid used in these and subsequent experiments acts on vessels made of glass or glazed earthenware, all such vessels were covered with a thin coating of parafin wax, and all measuring vessels were regraduated in consequence.

A satisfactory solution having been obtained, its strength was estimated by the two methods which follow:—

Method I.—Measured volumes of the solution were titrated with a normal solution of potassium hydroxide, methyl-orange and litmus being used as indicators. Methyl-orange however was not found to be satisfactory, possibly on account of the formation of double fluorides of hydrogen and potassium, which prevented a distinct change in the colour of the indicator when the hydrofluoric acid was neutralised.

More reliance was therefore placed upon the experiments in which litmus solution was used, since this indicator was found to act quite satisfactorily.

Details of three experiments are given below.

Volume of acid solution (as finally used)	= 10cc.
,, water added - - - -	= 20cc.
Total volume of mixture - - - -	= 30cc.

This volume was divided into three parts, each containing 10 c.c. of mixture, or $3\frac{1}{3}$ c.c. of the acid solution used in final experiments. (The water was added because the volume of hydrofluoric acid available was small, and the strength of any new acid obtained would have to be estimated separately.)

	Experiment I.	Experiment II.	Experiment III.
Volume of acid taken - -	$3\frac{1}{3}$cc.	$3\frac{1}{3}$cc.	$3\frac{1}{3}$cc.
Volume of normal alkali required to neutralise - -	38·6cc.	38·45cc.	38cc.

Average volume of normal alkali required = 38·583cc.

Therefore acid solution is $\frac{38\cdot583}{3\cdot3}$ times normal.

But normal hydrofluoric acid solution contains 20 grams per litre. Therefore weight of hydrofluoric acid contained in one litre of solution as used for final experiments $= \frac{38\cdot583 \times 20}{3\cdot3}$ grams
= 231·5 grams.

Method II.—A small, measured volume of the acid was placed in an evaporating dish and covered with an inverted funnel. The whole was then weighed. Known weights of calcium carbonate were added until no more carbon di-oxide gas was evolved. The evaporating dish with its contents and the funnel were then weighed, and the weight of carbon di-oxide liberated was calculated. From the *data* thus obtained, the weight of hydrofluoric acid per litre was estimated as given below:—

Volume of acid taken - - -	= 4cc.
Weight of evaporating dish, acid and funnel - - - - - - -	= 85·073 grams.
Weight of calcium carbonate added -	= 2·527 ,,
Total weight - - - - - -	= 87·6 ,,
Weight of evaporating dish, contents and funnel after liberation of carbon di-oxide - - - - - - -	= 86·57 ,,
Weight of carbon di-oxide liberated	= 1·03 ,,
But 40 grams of hydrofluoric acid are required to liberate 44 grams of carbon di-oxide.	
Therefore weight of hydrofluoric acid in 4cc. of solution as finally used $= \frac{1.03 \times 40}{44}$ grams - - - -	= ·936 ,,
Therefore weight of hydrofluoric acid per litre of solution - - -	= 234·09 ,,

Since it is probable that a little water vapour escaped with the carbon di-oxide gas, the true weight of carbon di-oxide liberated should probably be slightly less than 1·03 grams, and consequently the strength of the hydrofluoric acid should be slightly less than 234·09 grams per litre.

It would appear, therefore, that the results obtained by Method I. are more exact, though the results obtained by Method II. serve as a valuable check.

The advisability of carrying out a more exact experiment by Method II. was considered, but abandoned, owing to the difficulty of coating delicate apparatus with material not acted upon by hydrofluoric acid.

B. Time tests.—Since some of the glazes contained a very small percentage of lead compounds, while others contained 40 to 60 per cent., the time during which the hydrofluoric acid should be allowed to act on the glaze was of great importance, for it was found that, with the particular strength of acid used, when the action was allowed to continue for twenty seconds only, the glazes with a low lead solubility gave very faint black stains, while if the action lasted for 60 seconds, the glazes containing higher percentages of soluble lead gave stains too dark for purposes of comparison.

Finally, it was decided to allow the hydrofluoric acid to act on the glaze for 40 seconds, and this has been found to give satisfactory results.

B. Transfer of the lead fluoride from the ware to the filter paper.—In the preliminary experiments very variable results were obtained owing to the fact that the lead fluoride, formed by the action of the hydrofluoric acid on the lead compounds in the glaze, is insoluble in water and hydrofluoric acid. Hence, when the filter paper was placed on the ware after the hydrofluoric acid had been acting for 40 seconds, it absorbed the spare acid and substances dissolved in it, picking up a certain amount of lead fluoride, but left the greater part of the lead fluoride on the ware.

Since lead fluoride is soluble in hydrochloric or nitric acid, attempts were made to absorb it by moistening the filter paper with one or other of these acids. The attempts failed because:—

(1) Sufficient hydrochloric or nitric acid could not be obtained on a small piece of filter paper to dissolve all the lead fluoride.

(2) Time was necessary for the hydrochloric acid to dissolve the lead fluoride, and this could not be allowed since free hydrofluoric acid was in contact with the ware during the whole of this time, and consequently the value of the time tests referred to above was destroyed. Also the hydrochloric or nitric acid on the paper acted on the lead compounds in the glaze.

* See evidence of Sir H. H. S. Cunynghame, K.C.B., Questions 7772–80 and 8526–30.

(3) Since the filter paper was moistened with hydrochloric or nitric acid, on applying it to the ware, the hydrofluoric acid, instead of being absorbed by one small patch, was scattered over a much larger surface of paper, carrying with it the lead fluoride and consequently the shade of the deposit of lead sulphide was much lighter than it should have been.

The second objection could have been overcome by modifying the tests, but since reasons (1) and (3) were sufficient to render this method of removing the lead fluoride from the ware to the paper of doubtful value, the whole idea was abandoned.

The difficulty was overcome finally by using a fairly rough filter paper with a uniform surface, and exerting a slight sharp pressure when removing it from the ware. By this means it was found that the lead fluoride could quite readily be transferred from the ware to the paper.

D. Analysis of the glazes.—Except in cases where the ware was dipped in leadless glaze, an effort was made to obtain :—

(1) Samples of glaze.

(2) Samples of ware dipped in the glaze and fired in a glost oven.

Final Experiments.

Having concluded the preliminary experiments it remained to carry out the final tests with pieces of ware which, from their nature, and the kind of glaze in which they had been dipped, would be likely to show whether the test was of any practical value.

The ware selected contained

(*a*) Pieces which had been subjected to a hard fire.

(*b*) Pieces which had been subjected to an easy fire.

(*c*) Pieces dipped in glazes containing or reported as containing no lead.

(*d*) Pieces dipped in glazes containing from ·9 to 50 p.c. of lead.

(*e*) Pieces dipped in glazes containing other ingredients, such as compounds of manganese or cobalt as well as lead.

The experiments with the various classes of ware were finally conducted in the following manner

(1) A spot of hydrofluoric acid was applied to the ware by means of a quill pen and simultaneously a stop watch was started.

(2) At the end of 40 seconds a piece of rough filter paper with a uniform surface was applied; the liquid on the ware was absorbed, and the lead fluoride was transferred to the paper by means of a slight sharp pressure.

(3) The excess of hydrofluoric acid was driven off by warming the paper.

(4) The paper was placed in an evaporating dish containing fairly strong sulphuric acid (1 in 5 measured by volume), thus converting any lead compounds into the sulphate.

(5) The paper was placed in an evaporating dish containing distilled water. The water was kept in constant motion by gently rocking the dish. By this means any sulphates which were soluble in water were dissolved.

(6) The paper was removed to a dish containing ammonium sulphide, thus converting the white lead sulphate into the sulphide and forming a black stain.

(7) The paper was dried on a steam bath.

Conclusions.

After considering the results of 150 experiments made with ware dipped in as large a variety of glazes as was obtainable, it seems justifiable to come to the following conclusions :—

(*a*) The stains produced by the experiments as finally conducted, vary in depth of colour according to the proportion of lead in the glazes concerned.

(*b*) The depth of the stain is not affected by the presence in the glaze of compounds of metals other than lead (e.g., cobalt, manganese, copper, etc.).

(*c*) The test is consequently of great value in estimating approximately whether ware has been dipped in

(1) A leadless glaze.

(2) A glaze containing less than 2 p.c. of lead.

(3) A glaze containing less than 5 p.c. of lead.

(4) A glaze containing more than 5 p.c. of lead.

APPENDIX LI.

MEMORANDUM BY Dr. A. VERNON HARCOURT, M.A., F.R.S.

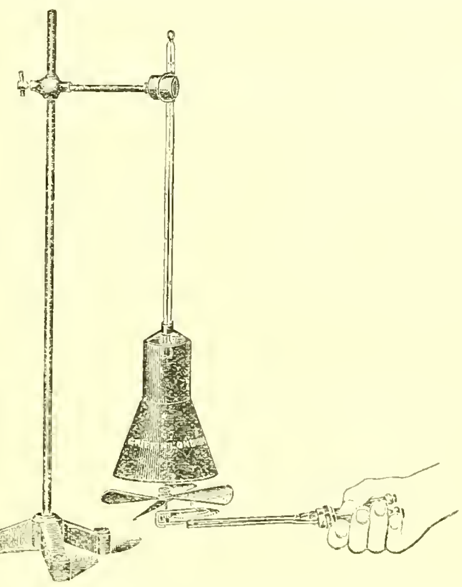
1. On the observation of Temperature with a Wet-Bulb Thermometer.

As it is proposed to place a thermometer in all the principal shops in which excessive heat is to be apprehended, the number of thermometers required will be very large, and it will be economical, as well as otherwise desirable, to have them made of one type which is suitable for the purpose. All the observations likely to be made are within the limits of 32° and 90° Fahr., and a thermometer graduated only over this range can combine a convenient length and an open scale, such as a length of rather more than one foot, or 34 centimetres, with an interval of five millimetres between one degree and another. It is sufficient if half-degrees are marked by a shorter line and if every fifth degree is numbered. Changes of temperature are shown most quickly by a rather long cylindrical bulb. The general type should be that of a "chemical" thermometer, with the graduations etched on the glass stem.

The common form of wet-bulb thermometer, to which water is supplied constantly by a wick, gives readings which are higher, when the air around is still, and lower when it is exposed to a draught; also the muslin coat becomes encrusted unless distilled or rain water is used. To get the full reduction of temperature due to evaporation, the air which has been moistened by contact with the wet bulb must be quickly replaced by fresh air. This may be done by swinging the thermometer, and so moving the bulb through the air, or by blowing or drawing air past the bulb. The former plan is the simpler, the latter rather more convenient, since a thermometer cannot be read while it is swinging and begins to rise when the swinging has stopped.

Such a thermometer as above described, with its bulb just inside the neck of a funnel whose open mouth receives the current of air from a small fan worked by the hand, answers the purpose well. A tin-plate funnel with a mouth four inches in diameter and a neck 1·5 inch in diameter and 3 inches in length, costs little, and one fan would serve for any number of thermometers.

It will probably be best for the thermometer to be



provided with a stand and clamp so as to be transferable from one room or one part of a room to another, and to be kept ready for use, but in a safe place when

there is no likelihood of the temperature being either too high or too low. The bulb, wrapped in a single fold of muslin, would not be wetted unless the thermometer stood above 70°. To make a wet-bulb reading, the funnel would be raised with one hand and a small bottle holding distilled water would be held up by the other hand so that the bulb was immersed in the water. On lowering the bottle a drop of water remains hanging to the bulb, more than sufficient to keep its coat wet during the time of an observation. The funnel is then put down into its former position, and the fan is spun immediately beneath it until the thermometer ceases to fall. Then a reading is made. The time required is from two to three minutes.

2. On the Estimation of the Dustiness of the Air.

A double-acting syringe has been arranged with a counter for registering the number of strokes. By connecting its inlet and the outlet of a tube through which air is to be drawn, with a two-holed cork in the neck of a bell-jar standing in water, the intermittent action of the pump is converted into a nearly constant rate of suction. A plug of cotton-wool, about $\frac{3}{4}$ inch in length and $\frac{1}{2}$ inch in thickness, is held in the tube, whose length is from three to four inches, against the pressure of the air by three internal projections. Such a plug when rammed moderately tight against its support forms a very effectual dust filter. After dried air has been aspirated through it for a quarter of an hour further drying does not change its weight. Two smooth and short corks are used to close the ends of the tube during weighing.

Counting both strokes, pull and push, as one, 20 strokes are easily made in one minute. The number of strokes which will draw through one cubic foot of air is found, and checked from time to time, by connecting the inlet of the pump with the outlet of an experimental gas meter. The pump is worked slowly so that the meter-drum may make about one revolution a minute for several minutes, and the desired ratio is calculated from the readings of the meter and of the counter. In the pump which has been constructed, the dimensions of the cylinder are such that about 34 strokes draw one cubic foot. In a moderately dusty room the dust collected from 10 cubic feet of air would be weighable; the pumping at the above rate would take 17 minutes. This time, which seems unduly long, could no doubt be reduced, by having a rather larger cylinder and quicker pumping, to 10 minutes. With a greater rate of passage of air it would probably be well to increase the diameter of the collecting tube to $\frac{3}{4}$ inch. After the dust has been collected it is necessary to aspirate dried air through the cotton-wool again for a quarter of an hour before weighing. Since the increase of weight may not exceed one or two milligrams, it is essential that the inspector who makes the testing should have the use of a delicate balance and be practised in accurate weighing. It would be impracticable to send the tubes to a distance to be weighed.

3. On the Determination of the Amount of Lead in Dust.

For a description of the apparatus and method proposed for the approximate estimation of small quantities of lead, reference may be made to a paper in the Journal of the Chemical Society (Journ. Chem. Soc., p. 841, vol. 97).

The investigation, of which some account is given in this paper, was undertaken for the Committee of which the writer had the honour of being a member; but many of the details are of a technical character, which, he thought, were more suited to an audience of chemists, than likely to be interesting to readers of the Committee's report. Some other points more nearly related to the work of the Committee are dealt with here.

A method proposed for the collection and estimation of dust would often be immediately followed by a further enquiry as to the proportion of lead present in the dust. It has been found that the extraction of lead from the plug of cotton-wool, in which the dust has been caught, can be effected by pouring dilute nitric acid (100 grams in a litre), a few drops at a time, through the tube containing the plug into a beaker of 40 or 50 c.cm. capacity; then—the dust having been laid—transferring the plug to the beaker, and stirring and pressing it with a light glass tube sealed at the lower end, while the liquid is gently heated; then letting fall directly into the liquid, not down the glass, a few drops at a time of hydrofluoric acid, giving a slight rotatory movement to the beaker. By working in this way the use of a platinum vessel may be dispensed with; in presence of nitric acid a liquid still turbid with minute particles of some silicate may be made perfectly clear, while the highly diluted hydrofluoric acid has no perceptible action upon the massive glass of the beaker. The volume of the solution is at this stage about 20 c.cm., partly the 10 per cent. nitric acid, partly water used to wash out the tube. It is passed through a small filter into a 50 c.cm. measuring flask. The beaker, the plug of cotton-wool—which is given a squeeze each time— and the filter are washed out thoroughly with successive small portions of water till the flask is filled to the line. Then, the liquid having been mixed by several inversions of the flask, a few c.cms., according to the weight of dust and the proportion of lead to be expected in it, are taken out with a pipette, and tested by addition of sulphuretted hydrogen, etc., in the manner described in the author's paper. If the colour is very faint, paler than, or as pale as, that due to half a centimilligram of lead, a larger part of the remaining liquid is used for the next testing. It is always well, if possible, to make two or three testings with different quantities of the same liquid, and thus both to test the accuracy of the result and to gain the advantage of taking a mean.

With stronger nitric acid, or if a drop or two of strong acid is added to the liquid beneath which lies the plug of cotton-wool, a yellow colour appears which interferes with the subsequent colour-testing. But if the above directions are followed the liquid is perfectly colourless till hydrogen sulphide and sodium acetate have been added.

4. On Low-Solubility Glazes and Frits.

There is little for me to add to, and still less to subtract from, what was proposed and established many years ago in regard to low solubility by my friend and fellow-chemist Sir Edward Thorpe. He needed to provide a conventional definition of a method for estimating degrees of solubility, and the figures found by his method are not likely to differ by much from those which would be found by slightly different methods of partial solution; for the proportion of soluble lead in any sample is largely due to the frit not being homogeneous. Some of the lead oxide has failed to combine with the excess of silica and the alumina provided for it, and chiefly forms the soluble part. But some lead oxide, though uncombined, is doubtless surrounded by and sealed up in the insoluble portion, and thus mechanically escapes solution. Hence rather more is dissolved when a sample is reduced to finer powder. Again, the proportion dissolved may be considerably increased by digesting at the body-temperature, 37° C. In the case of a frit sent me by Mr. Thomason, the percentage soluble at 15° C. was only 2·5; at 37° it was 3·6. But I ought to add that, as I have only worked with a few samples, my experience is not to be compared with that of Sir E. Thorpe; and also that for want of a shaking machine, I have not followed his process exactly, but have only given the flask containing the powdered frit and large excess of 0·25 per cent. hydrochloric acid a shake round every few minutes for a couple of hours. Were it not for the authority of the existing practice, I should ask sanction for reducing the frit or glaze to an impalpable powder in an agate mortar, for the use of the temperature of digestion, and, since shaking machines are not generally available, for frequent hand-shaking during the time of digestion.

The test of solubility in an acid may have lost some of its significance now that it is believed that lead passes into the blood less by solution in the acids of the stomach than through the lungs. But the difference is all in favour of the low-solubility frit. Lead oxide or carbonate dissolves to a considerable extent in water containing carbonic acid, which I suppose to be the only free acid on the surface of the lungs; but a low-solubility frit, which yielded 3·9 per cent. of lead to 0·25 per cent. hydrochloric acid, having been digested for $1\frac{1}{2}$ hours with a solution of sodium carbonate and then exposed for half an hour to a current of carbonic acid, showed not a trace of lead in solution.

5. Miscellaneous.

Leadless Glaze.—We have often been told that a trial of leadless glaze gave at first promising results, but that by degrees the results became less and less satisfactory. The reason assigned is that at first the lead glaze re-

maining in the grinding pans and the lead-washing of the sagger supplied a sufficient quantity of the useful ingredient. If the part which the sagger supplies is enough to produce a good result, I cannot understand why the good result cannot be perpetuated by using a leadless glaze, and supplying every sagger, either as a wash or in a small iron tube, with a little dose of lead sufficient to give as it volatilises to the upper surface of the actual glaze the brightness and smoothness of a lead glaze. Such a use of a vapour within the sagger would seem to correspond to that use of a volatile chloride by which the effect of flow blue is produced.

Lathe Treading.—May I mention here another opinion which I have formed? Some evidence has been given us against the employment of girls for turning lathes by working a treadle with the foot, the accepted view being that they must always stand on one foot, and work the other, and that this is liable to cause unsymmetrical development and curvature of the spine. It is so well established that bicycles have greatly promoted the health of girls that the employment would, I believe, be thought suitable for them, but for its one-sided character. I have worked much with the foot-bellows of a blowpipe. When one leg is tired I move a few inches and use the other. I do not understand why it should be impossible so to construct and place a treadle as that it can be worked by each leg in turn. Whatever the difficulty may be I hope some ingenious mechanic will overcome it, and enable these girls to earn their wages by what would then, if not continued for too long a time, be a healthy form of exercise.

On Testing the Glaze of Finished Ware for Lead and for the Amount of Lead.—The readiest way of finding out whether there is any lead in the glaze on any article of china or earthenware, is to let fall upon some part of the surface, which is either concave or flat, a drop of hydrofluoric acid, to warm gently till vapour has almost ceased to rise, and then to let fall upon the same spot a drop of solution of sulphuretted hydrogen. If no darkening occurs, the glaze is leadless; if there is lead in the glaze, the surface, which has been acted on, becomes black or brown according to the greater or less amount of lead. This method is nearly that which was shown to the Committee by Sir Henry Cunynghame.

A test of this kind does not distinguish between glazes of high and low solubility, nor does it give more than a very rough indication of the total proportion of lead. Some attempts were made to estimate the amount in the glaze covering a measurable surface by acting upon the glaze with hydrofluoric and hydrochloric acids, the surface to be acted upon being limited in the case of a flat surface, such as that of a plate, by warming it gently, and then standing upon it short cylinders of beeswax which attach themselves water-tight. But the attempt was essentially faulty, since as soon as the glaze has been removed the solution sinks into the porous body, or runs out where the junction of glaze and beeswax has been undermined. The right method is to rub off the glaze with a carborundum file, working slowly and avoiding movement of the air, to brush carefully off the file into an agate mortar for reduction to a fine powder, and to treat a weighed amount either with 0·25 per cent. hydrochloric acid, alone, or with this after heating in a platinum capsule with hydrofluoric acid. The former solution, tested by the colour test, gives the amount of lead soluble in very dilute acid, the latter the total amount of lead. In Germany it is thought necessary to protect the public generally from lead poisoning by requiring that earthenware vessels used for cooking shall be such as that acetic acid of 4 per cent., after having been heated to boiling in them for half an hour, shall not darken in colour when mixed with sulphuretted hydrogen. In England there is no such limitation, and it has been suggested that cooking utensils which fail to satisfy the German test are sold here. Perhaps the reason of the difference is to be found in the nature of the food of the poorer class in the two countries. Cabbage, which has been heated with vinegar, is not here a common article of diet.

Hoods.—Two forms of hood have been made for me by Mr. Burton, one having a hinged glass panel, which either forms part of the sloping roof of the hood when open to its full height or is lowered so as to increase the draught and interpose a pane of glass between the source of dust and the face of the worker. In the second, which may be of use where no fan and duct are available, a lamp or gas-jet within the hood, surmounted by a four-inch stove-pipe passing into a larger pipe overhead with an outlet into the air, creates the in-draft.

Flint Dust.—If the larger grains of powdered flint when separated from the exceedingly fine particles, which fall so slowly through the air that they may be inhaled as dust, would serve to support articles of china in a sagger, might not a process of winnowing be applied to this material before it is thus used? It could soon be found how far a stream or sheet of powdered flint needed to fall through an air-current of what velocity for this dust to be blown into a large drain along the bottom of which water ran.

A possible remedy for the evils caused by flint dust is the use of some less sharp-edged material, which should be abundant, readily reduced to powder, and capable of bearing a temperature not less than 1300°C. As to the existence of a material possessing these qualities I have consulted an eminent petrologist, Dr. T. G. Bonney, who has been kind enough to go very fully into the question. He suggests Serpentine as the likeliest, and as worth a trial. Its melting point is above 1340° C.; a block could be easily obtained from one of the Lizard quarries and ground up like flint; the dust would be much less harmful. If an experiment promised well, the material in bulk should be cheap, for the rock that is too much cracked or otherwise unsuited for ornamental purposes might be used.

APPENDIX LII.

TABLES SHOWING THE INCIDENCE OF MISCARRIAGES AND STILL-BIRTHS AMONG CERTAIN CLASSES OF NORTH STAFFORDSHIRE WORKERS.

PART I.—TABLES A and B. based on returns made to Dr. G. REID by special investigators visiting mothers at their homes during 1908 and 1909, in connection with the general Home Office Inquiry into certain maternity conditions.

TABLE A.

MISCARRIAGES, STILL-BIRTHS, AND CHILDREN BORN ALIVE DURING PERIOD OF MARRIED LIFE; ALSO CHILDREN BORN IN 1908 AND NUMBER OF THESE WHO DIED WITHIN ONE YEAR.

Class.	Number of Records.	Mean Ages of Mothers.	Number of Mothers having Miscarriages.	Number of Miscarriages.	Number of Mothers having Still-births.	Number of Still-births.	Number of Mothers having Miscarriages and Still-births.	Number of Miscarriages and Still-births.	Children born alive.	Deaths under one year among Children born in 1908.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Housework - - - - - - - - - -	2,812	31·3	450	771	300	443	676	1,214	11,201	424
Factory, etc. workers (not in lead) - - - - -	984	26·5	91	137	83	113	162	250	2,289	211
Mother—lead worker previous to marriage - -	121	30·0	31	78	8	13	37	91	449	19
Mother—lead worker since marriage - - -	70	29·4	21	58	10	19	26	77	218	19
Father—lead worker - - - - - - -	148	29·4	25	44	11	14	34	58	480	28
Totals and means - - - - - -	4,135	30·0	618	1,088	412	602	935	1,690	14,637	701

TABLE B.

MISCARRIAGE AND STILL-BIRTH RATES CORRECTED FOR PERIOD OF MARRIED LIFE, AND DEATHS UNDER ONE YEAR PER 1,000 BIRTHS.

Class.	Number of Records.	Mean Married Period.	Percentage of Mothers having			Among Mothers having Miscarriages or Still-births—Number per Mother.			Number per 100 Mothers.			Number of Children born alive per Mother.	Deaths under one year per 1,000 Births.
			Miscarriages.	Still-births.	Miscarriages and Still-births.	Miscarriages.	Still-births.	Miscarriages and Still-births.	Miscarriages.	Still-births.	Miscarriages and Still-births.		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Housework- - - - - - - - -	2,812	9·8	16·0	10·6	24·0	1·7	1·4	1·8	27·2	14·8	43·2	3·9	150
Factory, etc. workers (not in lead) - -	984	9·8	9·2	8·4	16·4	2·9	2·5	2·9	26·6	21·0	47·6	4·5	214
Mother—lead worker previous to marriage	121	9·8	25·6	6·6	30·6	2·9	1·8	2·8	74·2	11·8	86·0	4·3	157
Mother—lead worker since marriage -	70	9·8	30·0	14·3	37·1	3·3	2·3	3·6	99·0	32·8	133·5	3·9	271
Father—lead worker - - - - -	148	9·8	16·9	7·4	22·9	2·1	1·6	2·1	35·5	11·8	48·0	3·8	189

Part II.—Tables C and D, based on returns obtained by Dr. G. Reid in a second (special) inquiry, in which mothers actually at work in lead processes were questioned at the factories. (March, 1910.)

TABLE C.

Miscarriages and Still-births subdivided as to Class of Lead Work.

Class of Lead Work.	Number of Records.	Mean age of Mothers.	Number of Mothers having Miscarriages.			Number of Miscarriages.			Number of Mothers having Still-births.			Number of Still-births.			Number of Mothers having Miscarriages and Still-births.			Number of Miscarriages and Still-births.		
			Before 1906.	After 1906.	Total.	Before 1906.	After 1906.	Total.	Before 1906.	After 1906.	Total.	Before 1906.	After 1906.	Total.	Before 1906.	After 1906.	Total.	Before 1906.	After 1906.	Total.
I. Dipping house	136	32·1	15	14	26	24	17	41	12	6	17	18	7	25	27	20	43	42	24	66
II. Majolica workers	45	34·8	6	3	9	12	5	17	2	2	4	2	2	4	8	5	13	14	7	21
III. Decorative processes	52	34·7	6	3	9	9	4	13	2	1	2	2	1	3	8	4	11	11	5	16
Above processes combined	233	33·4	27	20	44	45	26	71	16	9	23	22	10	32	43	29	67	67	36	103

TABLE D.

Miscarriage and Still-birth Rates corrected for Period of Married Life.

Class of Lead Work.	Number of Records.	Mean Married Period.	Percentage of Mothers having			Among Mothers having Miscarriages and Still-births.—Number per Mother.			Number per 100 Mothers.		
			Miscarriages.	Still-births.	Miscarriages and Still-births.	Miscarriages.	Still-births.	Miscarriages and Still-births.	Miscarriages.	Still-births	Miscarriages and Still-births.
I. Dipping house	136	9·8	19·11	12·50	31·61	1·45	1·35	1·41	27·32	16·87	44·57
II. Majolica workers	45	9·8	20·0	8·88	28·88	1·38	0·73	1·18	27·60	6·48	34·07
III. Decorative processes	52	9·8	17·3	3·84	21·15	1·07	1·11	1·07	18·51	4·26	22·60
Above processes combined	233	9·8	18·8	9·8	28·7	1·32	1·14	1·26	24·81	11·17	36·1

APPENDIX LIII.

Correspondence with the Secretary of the English China Manufacturers' Association.

A. *Letter to the Secretary of the English China Manufacturers' Association—forwarded through the Chairman of the Association, Mr. S. L. Plant, in consequence of a change of Secretary shortly before the date of the letter.*

Departmental Committee on Lead, &c., in Potteries.
Home Office,
16th February, 1910.

Dear Sir,—It has been reported to my Committee that statements have been made, in the course of speeches in the recent election campaign, to the effect that the representatives of your Association who attended before my Committee to give evidence were instructed to advocate the exclusion of women from dipping house processes, or were at least empowered in the name of your Association to agree to such an exclusion so far as concerned the China manufacturers represented by your Association.

My Committee wish me to ask if you would be so good as to inform them whether such instructions were given to your representatives who came before us; or, in the absence of such instructions having been given, whether your Association desires to advocate such exclusion of women.

I am,
Yours faithfully,
(Signed) E. A. R. Werner,
Secretary.

The Secretary of the English
China Manufacturers' Association.

B. *Reply to above letter.*

The English China Manufacturers' Association,
Sutherland Road,
Longton, Staffs.
17th March, 1910.

Dear Sir,—Mr. S. L. Plant has handed me your letter dated 16th ultimo.

With reference to the subject matter of your letter, I am instructed to say that the representatives of our Association (Messrs. S. L. Plant and A. Woolley) who attended before your Committee to give evidence, were not instructed to advocate the exclusion of women from dipping house processes, nor were they empowered, in the name of our Association, to agree to such exclusion. Our representatives also deny that they have made any such statement as to the employment of women in dipping house processes.

With regard to your last question, my Committee do not desire to advocate such exclusion of women from the processes named.

Yours obediently,
(Signed) J. Arrowsmith,
Secretary.

E. A. R. Werner, Esq.,
Departmental Committee on Lead,
&c., in Potteries, London.

APPENDIX LIV.

GLOSSARY OF TECHNICAL TERMS USED IN THIS REPORT.

Compiled by the Secretary.

AEROGRAPHING. The application of colour or glaze in the form of spray by means of an aerograph instrument worked by compressed air.

BACK CLAMMINGS. Sections of temporary brickwork near the top and at the sides and back of an oven, the knocking out of which establishes a through cross draught from the ordinary clammings in the front and all the fire-mouths.

BALL CLAY. A clay found in Devon and Dorset, more plastic than china clay, but not so white.

BALLER. A thrower's attendant, who weighs out balls of clay of the size required for each article, and generally also takes the thrown article and places it on a board ready for carrying to the drying stove.

BARS for testing temperatures. Strips of compressed mixed silicates of varying fusibility carried on a frame which supports their ends only; at a certain temperature the first strip bends and the others in turn follow suit as the temperature rises; by the time the fourth or fifth strip begins to sag the first one has probably collapsed altogether.

BAT (1). (*a*). A flat slab of clay used by pressers in moulding articles, made either by "batting" a lump of clay by hand on a stone slab, or by a "batting machine."

(*b*) Also used to denote a flat slab of fireclay used as a shelf in saggers, or in kilns.

(*c*) A rectangular or circular slab of "plaster of Paris."

BAT (2). A flail of paper or similar material used in the "batting" of china biscuit ware; the ware is struck smartly with the bat in order to remove any dust from the surface before underglaze prints are applied.

BEDDING. A method of preparing flat clay ware for the biscuit firing, by placing it in a sagger or box which is completely filled with powdered flint.

BISCUIT or BISQUE. Ware which has been fired once before the application of the glaze.

BISCUIT EMPTYING. Removing biscuit ware from receptacles; more particularly from baskets in which it has been carried from the oven to the china scouring shop.

BISCUIT FIRING. Firing the oven or kiln containing unfired clay ware, to convert the latter into biscuit ware.

BISCUIT OVEN or KILN. A furnace in which unfired clay ware is converted into biscuit ware.

BISCUIT PLACING. Arranging pieces of unfired clay ware in saggers in readiness for the biscuit firing.

BOARDS. Planks generally about 6 feet long by 9 or 10 inches wide and 1 inch thick, on which a number of articles are placed for transport.

BODY. The porous substance of the ware made either of simple native clay unmixed with other ingredients, or composed of several, such as Cornish stone, china clay, combined in the case of British china with calcined bone, or in that of earthenware with ball clay and calcined flint.

BONE or BONE ASH. An ingredient largely used in china bodies. Bones are calcined and ground with water to a fluid mixture known as "slop" bone.

BONE CHINA. China, the body of which contains a large percentage of calcined bone.

BOSS. The pad used by a printer to remove superfluous colour from the engraved copper plate.

BUNG. A pile consisting of a number of similar articles, such as "a bung of plates," a "bung of saggers."

BURNISHING of Gold. A polishing of the gilt surface with tools of agate, bloodstone, hæmatite, etc.

CALCINED BONE. *See* "Bone."

CALCINED FLINT. *See* "Flint."

CASTING. The making of articles of pottery from clay slips poured into porous moulds; the clay sets slowly on their inner surfaces owing to absorption of water by the mould, and after a certain time the remainder of the liquid is poured out, leaving behind the clay articles as a deposit in the mould.

CHARGE OF GLAZE OR FRIT. The quantity of glaze or frit which is made at one mixing or grinding, for the frit kiln or the grinding pan, as the case may be.

CHINA. (1) Generally all translucent ware, including also Parian ware (*q.v.*)

(2) Particularly, as in official classification, bone china only.

CHINA CLAY (Kaolin). The final decomposition product of Cornish stone freed from admixed impurities by washing and sedimentation.

CHINA FURNITURE. A class of ware including the innumerable small pieces which do not, as a rule, appear by themselves in crockery shops, but are used in the construction of other articles or in conjunction with them. They are of infinite variety; heat insulators for teapot handles, eyelet rings for looms, door knobs and castor rollers may be cited as examples of them, as well as such products as finger plates, nest eggs, ink wells, and electrical fittings for purposes of insulation. Most of this ware is made with an earthenware body, but a proportion of many kinds, such as castor bowls and milliners' window fittings, are manufactured in the same way as Jet (*q.v.*)

CLAMMINGS. Temporary brickwork used to close the mouth of an oven when ready for firing. *See also* "Back Clammings."

CLAY or POTTER'S CLAY. The prepared native clay or mixtures of clay with other materials when ready for the working potter.

CLAY SHOP. *See* "Potters' Shop."

CLAY WARE. Unfired articles of pottery.

COARSE WARE. Earthenware of a common or rough quality, frequently made from a local clay without admixture, and dipped without previous firing in a simple lead glaze compounded from red lead or galena, or in a leadless glaze.

COLOUR BLOWING. Application of colour in the form of spray; aerographing of colour (*q.v.*).

COLOUR DUSTING. (1) A process carried on in connection with printing; the design is impressed by means of engraved plates on tissue paper with an oily medium, either coloured or uncoloured; the tissue paper with the pattern is transferred to the ware, the paper plucked off, and powdered colour then dusted over the piece of pottery, adhering to the faint pattern of the oily medium. This process is also called, locally, "plucking and dusting."

(2) Colloquially, for any "oiling and dusting." It is, however, convenient to regard as "ground laying" (*q.v.*) all dusting of colours on grounds, bands, etc., applied with a brush, reserving the term "colour dusting" for such work on patterns applied by the printing method.

CONES for testing temperatures. SEGER CONES. Pyramidal tetrahedra, roughly 6 cm. high and 0·5 cm., on each side of base, of compressed mixed silicates, etc., of varying fusibilities; as the temperature rises, these cones in turn bend over at the apex, and so afford the fireman a guide as to the progress of the firing.

CORNISH STONE. A partially decomposed granite found in the extreme south-western counties of England; when completely decomposed, it passes over into impure china clay.

CRAZING. The appearance of a fine network of cracks on the surface of the glaze, a defect which sometimes becomes apparent at once, sometimes not until months after the ware is finished.

DIPPING. The immersion of ware in fluid glaze.

DISINTEGRATOR. A machine, used mostly in tile factories, for reducing dry clay to a powder.

DOBBIN. A revolving door of a drying chamber. Dobbins are of two kinds:—

(*a*) The *two-sided dobbin*, which consists of a reversible door, pivotted vertically in the middle. It stands between the workroom and a heated chamber, and, on either side, it is fitted with shelves which, when facing the workroom, are filled with the boards and their burden of clay-ware. The door is then reversed and the ware thus brought into the drying-room. As soon as it is sufficiently dry the process is repeated with a fresh supply of clay ware.

(*b*) The *four-armed dobbin*, which practically consists of two doors similar to those of the two-sided dobbin, bisecting one another. The opening between the hot chamber and the workroom is so arranged that three-quarters of the dobbin face towards the former, whilst the remaining one-quarter presents itself as a V-shaped cupboard facing the latter. As each quarter is filled, the dobbin is pushed round one-quarter of a revolution, and the next section emptied and refilled with moulds and ware.

DRAWING OF OVENS. The removal of saggers of ware from the ovens after firing.

DRYING STOVE. The heated chamber in which clay ware is placed in order that it may give up the greater part of its moisture. *See* "Dobbin" and "Stillage Room."

EARTHENWARE. As distinguished from china, etc.: the great bulk of opaque ware, plain and decorated, made principally for domestic and general use; the body is usually made up of ball clay, china clay, flint and stone.

EARTHENWARE WORKS. Any place in which persons work for hire in making or assisting in making, finishing or assisting in finishing earthenware or china of any description, except bricks and tiles not being ornamental tiles.

EDGING (1). The scraping and finishing of the edges of pieces of clay-ware before firing.

EDGING (2). The ware cleaning of tiles by scraping their edges after dipping.

ELECTRICAL FITTINGS. Articles of pottery intended to be used for the insulation of electrical conductors. This class of ware is grouped with, and frequently included in, China Furniture.

EMPTYING BISCUIT. *See* "Biscuit Emptying."

ENAMEL COLOURS. Colours used for on-glaze decoration of pottery.

ENAMEL KILN. A muffle-kiln for firing articles of pottery which have been decorated with enamel colours. Generally the enamel kiln is a large rectangular box with a domed roof, but many continuous kilns are now in use in which the ware, carried in skeleton baskets of iron, is worked through a circular kiln into the fire zone, being gradually heated and cooled again in its passage.

ENAMEL PAINTING. The on-glaze decoration of pottery with colours, ground in oil or other suitable medium, applied by a brush to the fired glaze.

FAIENCE. (1) As an English trade term: articles of pottery intended mainly for architectural purposes and decorated with rich coloured glazes.

(2) As properly applied to Continental earthenware as distinguished from porcelain; earthenware made of any light-burning red or yellow clay, the colour of which is entirely disguised by a coating of white enamel, which is generally rich in lead and tin oxides.

FELSPATHIC CHINA or Porcelain. China in the body of which felspar is used to obtain the necessary translucence. Quite distinct from Bone China (*q.v.*).

FETTLING. The work of finishing a clay article by removing irregularities, straightening edges, smoothing the surface, etc. The word is used occasionally in its more limited and stricter sense for removing, by a tool, the inequalities along the seam or line of junction of two moulds; in this

Report, however, it is used in its widest sense so far as relates to processes carried out on unfired clay ware.

FILTER-PRESS. A press in which the excess of moisture is squeezed out of a slip in the preparation of plastic clay.

FINE BRUSHING. A final brushing by hand of china which has been scoured.

FINISHING. A term occasionally used to include many of the clay-fettling processes.

FIRED-FLINT-SIFTING. The sifting of powdered flint which has been used for the bedding or flinting of flat ware in the process of biscuit firing.

FLAT-KNOCKING. The shaking of powdered flint from between newly fired flat articles, which have been bedded for biscuit firing, by knocking the edges of a pile of such biscuit ware on a leather pad.

FLAT PRESSING. The shaping of dishes, plates, saucers, and other articles which are technically termed "flat," as distinct from "hollow" ware. A "bat" of clay is pressed down on to a mould and worked until it is in complete and close contact with the mould.

FLINT. An ingredient largely used in pottery bodies. Flint stones are calcined, broken, and ground in water to the form of a slip. Used also as a dry powder for packing china, etc., for the biscuit firing.

FLINTING. A method of preparing clay ware for the biscuit firing, by placing the articles in a sagger or box with layers of powdered flint to separate them, but without filling the sagger or box completely with the powdered flint.

FLOW MATERIAL. A substance placed in saggers with a view to its entire or partial volatilisation during the glost firing of printed ware; the vapours arising from the flow material have the effect of softening the outlines of the printed pattern on the ware.

FRIT (1) noun. A simple or compound silicate or mixture of silicates and silico-borates resembling glass.

(2) verb. To melt together ingredients of a frit or a glaze preparatory to their use in finished glazes suitable for application to a piece of pottery.

FRIT KILN. A reverberatory furnace in which frits are melted and run off as a glassy mass.

FURNTIURE. *See* "China Furniture."

GALENA. An ore of lead consisting of almost pure lead sulphide, which is sometimes used to produce the simplest type of lead glaze on some of the commoner forms of earthenware.

GATHERING at the mangle. Removing from the mangle ware on which the glaze has dried, and placing the articles on boards or in bungs.

GILDING. Decorating with finely divided gold suspended in a suitable medium and applied to the surface of glost ware, which is afterwards fired again in a kiln.

GLAZE (*a*) before firing. A fluid preparation of various silicates or silico-borates, to which is usually added a lead compound, which is applied to the surface of ware by dipping, painting, blowing or other process.

(*b*) after firing. The vitrified outer skin of a piece of pottery which renders a porous body impermeable by fluids.

GLAZE BLOWING. The application of glaze in the form of spray by means of compressed air.

GLAZE KETTLE. An implement generally used in glaze blowing; the glaze is put into a vessel resembling a closed kettle, and the pressure of compressed air is applied to the surface of the fluid, causing it to be blown from the spout in a fine spray.

GLOST FIRING. The firing of ware after it has been dipped in glaze.

GLOST OVEN or KILN. The oven in which ware coated with unfired glaze is fired so as to produce the vitrified outer skin known as glaze on finished ware.

GLOST PLACING. Arranging pieces of ware coated with unfired glaze in saggers, boxes or kiln chambers in readiness for the glost firing.

GLOST SAGGER HOUSE. The workplace in which glost placing is done; also called the glost placing shop.

GLOST WAREHOUSE. The place in which glost ware is stored after the glost firing.

GREEN. (1) Unfired (used of clay, powdered flint, etc.).

(2) of clay ware before firing, denotes the state in which the clay still retains sufficient moisture to have a dull green or grey appearance.

GROUND LAYING. A method of applying colours, in practice largely confined to on-glaze decoration; a pattern or ground is first painted on white glazed ware, whether earthenware or china, with an oily medium, and dry powdered colour is dusted over it with a pad of cotton wool; the colour adheres wherever the medium has been applied, and any falling elsewhere on the piece is removed by wiping with a piece of clean cotton wool or other suitable material.

GROUND PITCHER. Broken pieces of fired ware ground to powder.

HARDENING-ON. A kiln firing of biscuit ware to which prints have been applied, to drive off the oil used in the latter process before the articles are dipped in glaze.

HOLLOW-WARE PRESSING. The shaping of hollow articles, such as jugs, ewers, etc.; two half moulds are commonly used, a "bat" is pressed on each and trimmed off, the two halves being finally joined together, and attached to a base which has been made in a similar manner.

HOVEL. (*a*) The conical brickwork erection built over or outside a potter's oven or kiln to regulate the draught.

(*b*) Sometimes also applied to the space between the inner wall of the hovel and the outer wall of the kiln or oven.

JET. Ware made from simple brown or red clays and coated with a glaze containing sufficient cobalt oxide to render the finished ware black. Small quantities are made from special "jet bodies."

JIGGER. A vertical spindle carrying a revolving head which is rotated, usually by mechanical power, in a horizontal plane.

JIGGERING,* as applied to clay ware. The shaping of an article by hand and with a hand-tool on a mould rotated on the head of a jigger.

JOLLYING.* The shaping of a clay article, by a semi-automatic tool called a profile, on or in a mould rotated on the head of a jigger.

KILN. (1) A muffle furnace in which articles to be fired are placed in an inner fire-brick chamber which can be heated to the required temperature without flame or gases from the fire entering the inner chamber or muffle.

(2) Used in some parts of the country to denote any kind of pottery oven or furnace.

See also "Enamel Kiln," "Frit Kiln," and "Slip Kiln.'

LATHE TREADING. The work of driving a lathe for a turner; in this operation the turner's attendant generally rests the weight of the body on the left foot and works the treadle with the right foot.

LAWNING COLOURS. Rubbing ground colours through a piece of fine silk lawn.

LAWNING GLAZE. Passing glaze through a sieve made of fine silk lawn or of fine woven metal threads.

LEAD-HOUSE. The place where lead glazes are prepared and stored for use.

LEADLESS GLAZE. (1) A glaze in the preparation of which no lead compounds have been used.

(2) In Rule 22 of the Code of 1901 it is laid down that glazes which contain less than 1 per cent. of lead shall be deemed to be leadless for the purposes of that code.

LITHOGRAPHIC TRANSFERS. Coloured designs on paper which can be transferred to the surface of glost ware.

LOOKING OVER BISCUIT WARE. The examination of printed biscuit ware, before it is dipped in glaze, with a view to the removal of specks of colour or other blemishes.

* Frequently used colloquially as interchangeable terms.

LOW SOLUBILITY GLAZE. A glaze the dried material of which contains only a small proportion of lead soluble in dilute hydrochloric acid, when tested in the manner prescribed in Rule 2 of the Code of 1903.

LUSTRE WARE. Ware which has been wholly or partly coated with a material containing metallic compounds which are reduced in the firing, thus imparting a metallic lustre to the surface.

MAGNETING. The operation of removing particles of iron from a fluid (such as glaze or slip) by passing it through a magnetic field set up either by permanent or electro-magnets.

MAJOLICA.† Decorative ware made of the same body as earthenware (or from red or yellow clays) with a glaze which, before application, has colouring oxides or pigments mixed or fritted with it.

MAJOLICA DIPPING. Dipping ware in a glaze with which colouring oxides or pigments have been mixed or fritted.

MAJOLICA PAINTING. The application by means of a brush, of glaze with which colouring oxides or pigments have been mixed or fritted.

MANGLE. A drying machine consisting of shelves, for the reception of newly dipped ware, which are moved slowly through a heated space. The shelves move either horizontally or vertically; in the latter case the apparatus is often called a "tower" mangle.

MIXING ROOM. A room in which the ingredients of a frit are mixed, in readiness for transfer to the bed of the frit kiln, or in which the ingredients of a glaze are mixed; the term is often used as synonymous with lead-house (*q.v.*).

MOTTLING. The process of applying a coloured glaze by means of a sponge or similar material to certain parts of the ware only, so as to produce a mottled effect.

MOULDS. Matrices, cast from plaster of Paris, in or on which articles are shaped from clay.

MUFFLE. *See* "Kiln" (1).

NAILED BOARDS. Boards intended for the reception of newly dipped ware and fitted with nails or spikes for holding special articles. *See also* "Pegged Boards."

OILING AND DUSTING. See "Ground Laying."

ON-GLAZE DECORATION. The application of ornament in colour, gold, etc., to ware after it has been glazed and fired to the glost state.

OVEN. A furnace for the firing of ware enclosed in saggers; usually applied to the circular type of furnace used in pottery manufacture.

PAINTING. The application to ware, by means of a brush or similar implement, of colours or glaze.

PANEL-CUTTING. Scraping the glaze from portions of the surface of articles which have been dipped in glaze, where these portions are intended to receive subsequent decoration.

PAPER-CUTTING. Cutting sheets of paper, on which designs have been printed, into pieces containing the right portions of the design for transferring to articles of pottery.

PARIAN WARE. A fine vitreous ware containing sufficient felspar to render it translucent at a temperature much below that needed for Continental porcelain. This ware, when glazed, is usually dipped in a lead glaze like English china.

PEGGED BOARDS. Boards intended for the reception of newly dipped ware, and fitted with pegs or stout spikes for holding special articles. *See also* "Nailed Boards."

PERSIAN PAINTED. A cheap variety of earthenware ornamented with highly coloured designs, frequently applied by the method known as sponge-work (*q.v.*).

PITCHER. Broken or waste pieces of fired ware.

PLUCKING AND DUSTING. *See* "Colour Dusting."

POLISHING. The removal of irregularities from the surface of glost ware by means of a small emery wheel, and a subsequent polishing of the abraded surface by wheels of softer material.

PORCELAIN. *See* "Felspathic China."

POTTERS' SHOP. A workroom where clay articles are fashioned, whether from plastic material, by the compression of dust, or by casting.

† Certain lightly tinted glazes are used on ordinary earthenware, tiles, &c., and these are not to be regarded as majolica glazes.

POTTERS' STOVE. A chamber for drying articles newly made from clay. *See also* "Dobbin," "Stillage Room."

PRESS-CLOTH. The material through which the superfluous water is filtered from clay slip in a filter-press.

PRESSING. (*a*) The moulding of clay articles from plastic clay.

(*b*) The moulding of articles from powdered clay in mechanical presses.

PRINTING. The decoration of ware by transferring to its surface patterns which have been first impressed on paper by means of an engraved roller or plate.

PROFILE. A tool used in pressing articles from plastic clay:—

(*a*) The hand profile, which is generally made in fired pottery.

(*b*) The machine profile, made in iron or steel and attached to a lever so that it can be pulled down and brought in contact with the clay as it revolves on the jigger head.

PUGGING. The passing of plastic clay through a pug-mill for the purpose of rendering the the material homogeneous and removing air-bubbles. For many purposes, but not for all, this is a substitute for the process of wedging (*q.v.*).

PUTTING-UP. The handing of unglazed articles to the dipper for immersion in glaze.

RAW LEAD. A lead compound such as the carbonate or oxide, which is used without being previously fritted.

ROCKINGHAM. Ware made from simple brown or red clay and coated with a glaze containing sufficient manganese to give the finished ware a rich brown hue. Small quantities are made from special "bodies."

ROLLING. The treatment of certain clays in a rolling-mill for the purpose of rendering the material homogeneous and removing air-bubbles. This method is of limited application to certain potter's clays that cannot be "pugged." (*q.v.*).

RUMBLER. A machine, for scouring biscuit ware which has been fired in flint, in which the articles are put in cradles or racks inside a drum, together with fragments of pitcher; the whole is rotated, and the pitcher scours the flint from the ware.

SADDLE OR STRIP. A straight piece of fired clay, with sharp edges, used for supporting an article during glost-firing.

SAGGER. A fireclay box used for containing ware during its firing in an oven.

SAGGER-WASHING. The painting or washing of the inside of saggers with a thin glaze, to prepare them for glost-placing.

SAND-BLAST MACHINE. A machine in which biscuit ware, which has been fired in powdered flint, is scoured by directing a jet of sand against each article by means of compressed air.

SAND-STICKING. The finishing of articles of sanitary ware by means of a long straight piece of wood, to which a piece of sandpaper or other rough material has been attached, and which is worked like a file up and down the edges or the surface of the article.

SANITARY WARE. Baths, closets, urinals, operating tables, lavatory basins, etc., whether made with a fireclay body, or one similar to that used for general earthenware.

SCOURING. (1) Of biscuit ware which has been fired in powdered flint—a cleaning process for the purpose of removing all particles of flint dust which may adhere to the surface of the ware.

(2) Of gold—a cleaning of the gilt surface with sand and water, often preparatory to burnishing (*q.v.*).

SCRAPING EDGES. The fettling or trimming of the edges of an article by means of a tool; frequently the article is rotated on a whirler and the scraping tool held against the edge.

SECONDS. Pieces not of first-rate finish, which, consequently, cannot be sold at the full market price.

SEGER CONES. *See* "Cones."

SETTING-IN. The carrying of saggers into an oven, in which they are piled up in columns or bungs; the placing of any kind of ware in an oven or kiln for firing.

SLAPPING. The forcible bringing together of two pieces of clay each small enough to be held in one hand.

SLIP. A fluid which is of a creamy consistency by reason of the quantity of finely ground solid matter in suspension in it. The term " slip " is generally used to indicate fluid mixtures containing clay. When the fluid contains only bone, flint or stone, it is generally known as " slop."

SLIP DECORATION. The ornamentation of clay articles by means of slips consisting of simple or mixed clays in water, colours being frequently added.

SLIP HOUSE. The place where the body of the ware is prepared from clays, etc., in slip form.

SLIP KILN. A large open tank with fireclay bottom and sides and flues underneath for heating; in this clay slips are heated to drive off the excess of moisture by evaporation.

SLOP. *See* " Slip."

SOLUBILITY, as applied to materials containing lead. The proportion of lead, in the dried weight of the material, which is dissolved in dilute hydrochloric acid when treated in the manner prescribed in Rule 2 of the Code of 1903.

SOLUTIONING. The plunging of printed biscuit ware, immediately before it is dipped in glaze, into a solution which will neutralise the action of the oil in the printing medium (instead of hardening-on).

SORTING. The removal of irregularities from the surface of glost ware by means of a tool somewhat like a cold chisel. The word " sorting " is also used in its ordinary significance of arranging pieces of ware, either biscuit or glost, in various grades of quality.

SPONGE-WORK. The application of coloured designs to biscuit ware by means of a hard sponge which is cut to the shape of a flower, leaf, or other simple design. *See also* " Persian Painted."

SPUR. A stand of fired clay used for supporting an article during glost firing; it resembles a miniature caltrop, having four points, three of which are always down and the fourth up.

STILLAGE. A rack for holding boards of ware.

STILLAGE ROOM. A form of drying chamber in which the ware is placed on stillages.

STILT. A stand of clay used for supporting an article during glost firing; it has generally three radial arms with upward and downward spikes at the end of each.

STONE. *See* " Cornish Stone."

STONE WARE. Earthenware of a hard homogeneous texture somewhat resembling stone; it is frequently made from a local clay without admixture, and is almost invariably coated with a leadless glaze without previous firing to the biscuit condition. Some kinds of fine stone ware are not glazed in the ordinary sense.

STOPPING, of biscuit ware. The filling up of cracks in pieces of biscuit ware.

STOVE. *See* " Potters' Stove."

STRIP. *See* " Saddle."

TAKING OFF. Taking a newly dipped article from the dipper, or from a mangle.

THIMBLE. A hollow conical piece of fired clay provided with a horn with a sharp edge, on which a piece of ware is rested during glost firing.

THIMBLE PICKING. The picking over, sorting, or re-arranging for further use, of thimbles, stilts, spurs, strips, saddles, or any similar articles which have been used to support pieces of pottery during the process of glost firing.

THREADING-UP. Stringing a number of small articles on a wire with a rubber or other washer between each in order that all may be dipped at the same time in glaze.

THROWING. The shaping of a clay article by hand on a potter's wheel.

TILE. A rectangular slab of pottery, generally made by the compression of clay dust.

TOWER MANGLES. *See* " Mangle."

TOWING. The smoothing of the surface and edges of a flat clay article (such as a plate) by pressing a wad of tow on it as it revolves on a jigger head.

TRANSFERRING. The conveying of patterns, either from a printed sheet or from a lithographic transfer sheet, to the surface of pottery ware.

TRANSFERS. *See* " Lithographic Transfers."

TREADING LATHES. *See* " Lathe Treading."

TRIALS. Small pieces of earthenware dipped in a glaze which changes colour according to the temperature reached. A number of " trials " are placed in the oven near a hole left for this purpose, and are withdrawn one at a time at intervals to ascertain the progress of the firing.

UNDER-GLAZE DECORATION. The application of coloured ornament to ware before it is dipped in glaze.

VITREOUS WARE. A variety of earthenware which is fired to such a high temperature that the " body " loses practically all its porosity.

WARE CLEANING. The removal of superfluous glaze adhering to an article to which glaze has been applied by dipping and other processes.

WASHING OFF. The removal, by washing the article, of the paper by which a print or lithograph has been transferred to the surface of the ware.

WATER TROUGHS. Receptacles into which glaze, scraped off in the process of ware cleaning, may fall.

WEDGING. The treatment of clay by raising one piece of clay by hand and bringing it down upon another piece.

WHEEL TURNING for throwing. Maintaining in motion, by hand, of a large light fly-wheel by which the potter's wheel is driven.

WHIRLER. A stand on which an article can be placed and caused to revolve by hand.

WHITE or WHITE HARD. Applied to clay ware, denotes the condition in which the articles have lost so much moisture that the surface appears white and dry.

WHITE WAREHOUSE. The warehouse in which ware is stored which has been glazed without coloured decoration; the ware is either sold in this form as " plain white ware " or is subsequently decorated by an on-glaze process.